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NOVEMBER 12, 1984 $3

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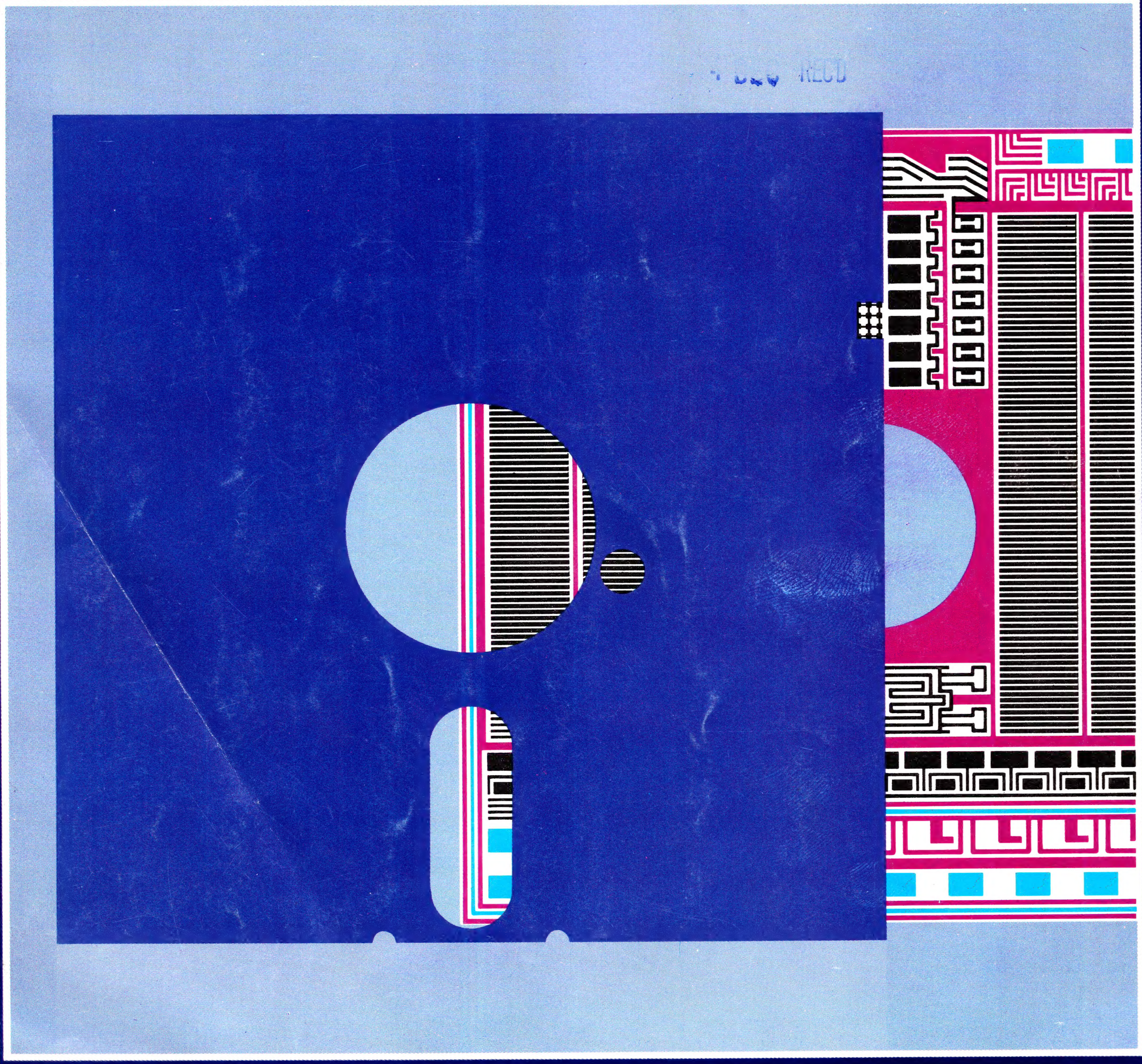

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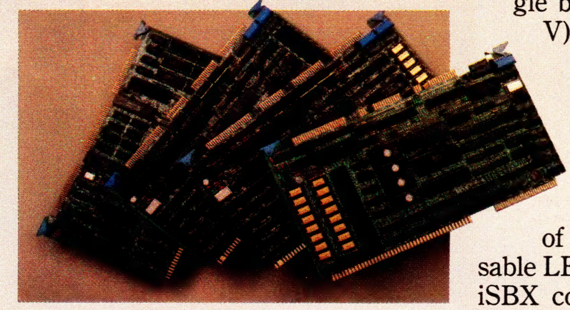

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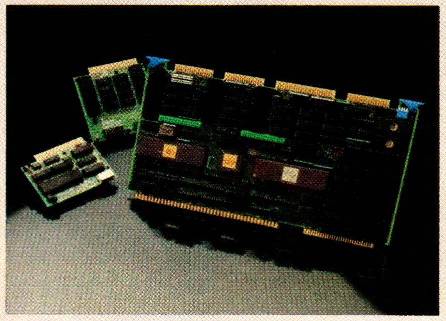

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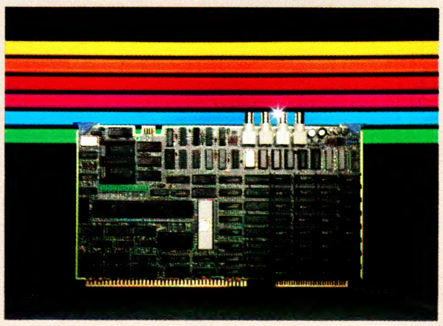

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Next ElectronicsWeek

Single-chip signal processors set to take off

The quickening pace of single-chip digital-signal-processor introductions points to the day when applications will mushroom, in much the same way that microprocessors were instrumental in driving the computer invasion all the way to the desktop. A large DSP market is expected—this is the carrot for chip houses, which hope that general-purpose digital signal processors eventually will find applications in communications systems of all kinds. Many players are in the market already. The full story will appear in the next issue of *ElectronicsWeek.*

Flexx arrays speed IC designs

A new semicustom integrated-circuit array combines the best features of standard cells and gate arrays in a powerful, easy-to-use design approach. Whether gate arrays or standard cells are employed, it is clear that the choice of a semicustom approach to a given project offers both drawbacks and advantages. The Flexx array approach to the design of ICs preserves the advantages of both gate arrays and standard cells at the same time that it eliminates many of the drawbacks. Bill Loftis and Herb Jasse will explain the Flexx array in next week's issue.

Looking ahead in ElectronicsWeek

Acoustic microscopes give makers of chip capacitors and hybrid microelectronic circuits the ability to test these parts for internal defects, such as cracks, both rapidly and nondestructively. Ranging from 7× to 400×, the magnification capabilities of these instruments resemble those of more-common light microscopes but offer the advantage of extreme sensitivity to internal discontinuities, both in light-transparent and light-opaque materials. Read about acoustic microscopes in an upcoming *ElectronicsWeek.*

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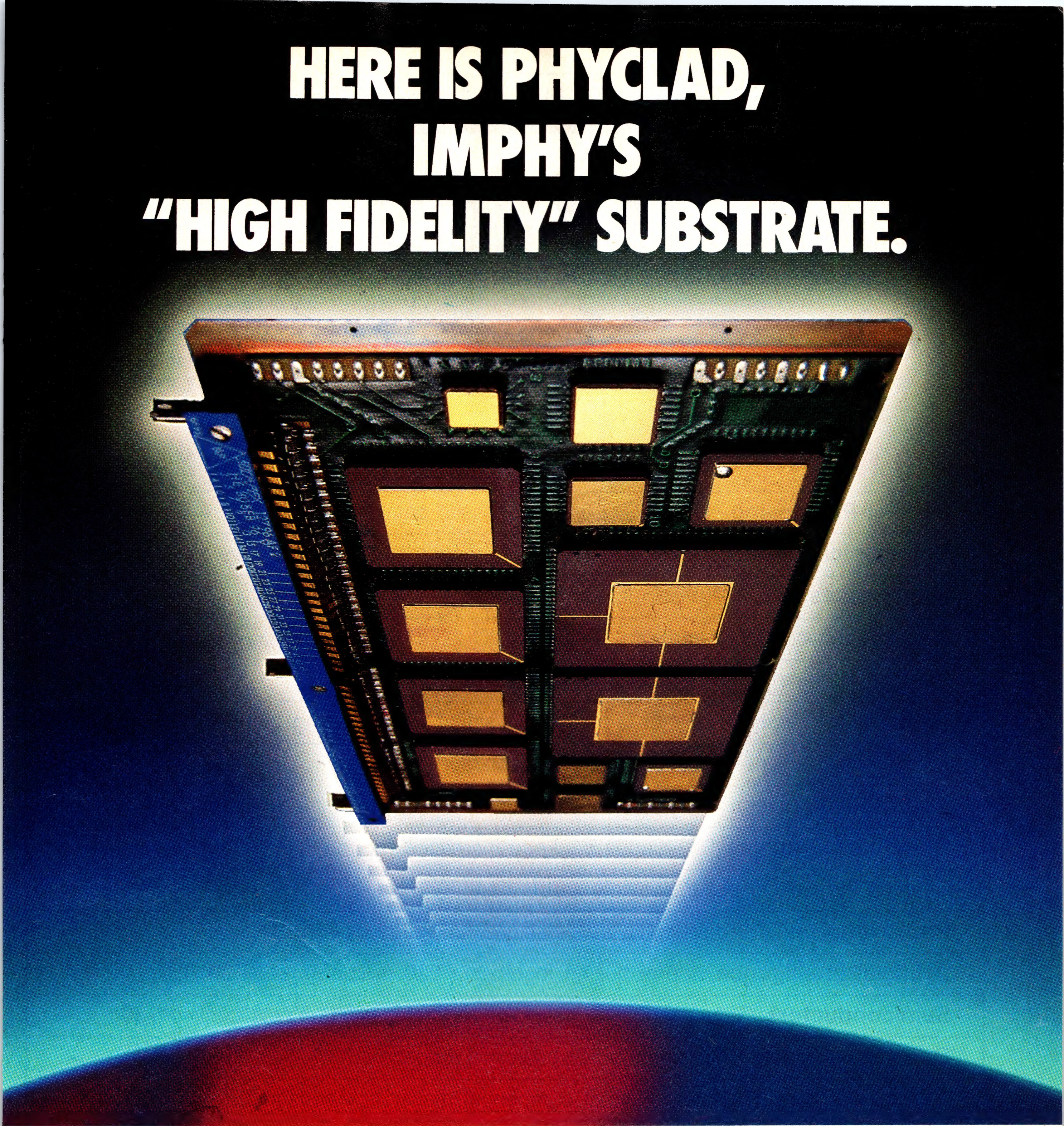

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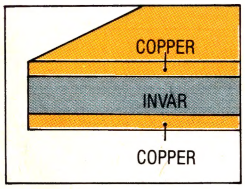

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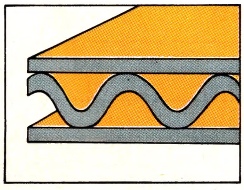

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THE VOICE OF THE INDUSTRY, HEARD EVERY MONDAY

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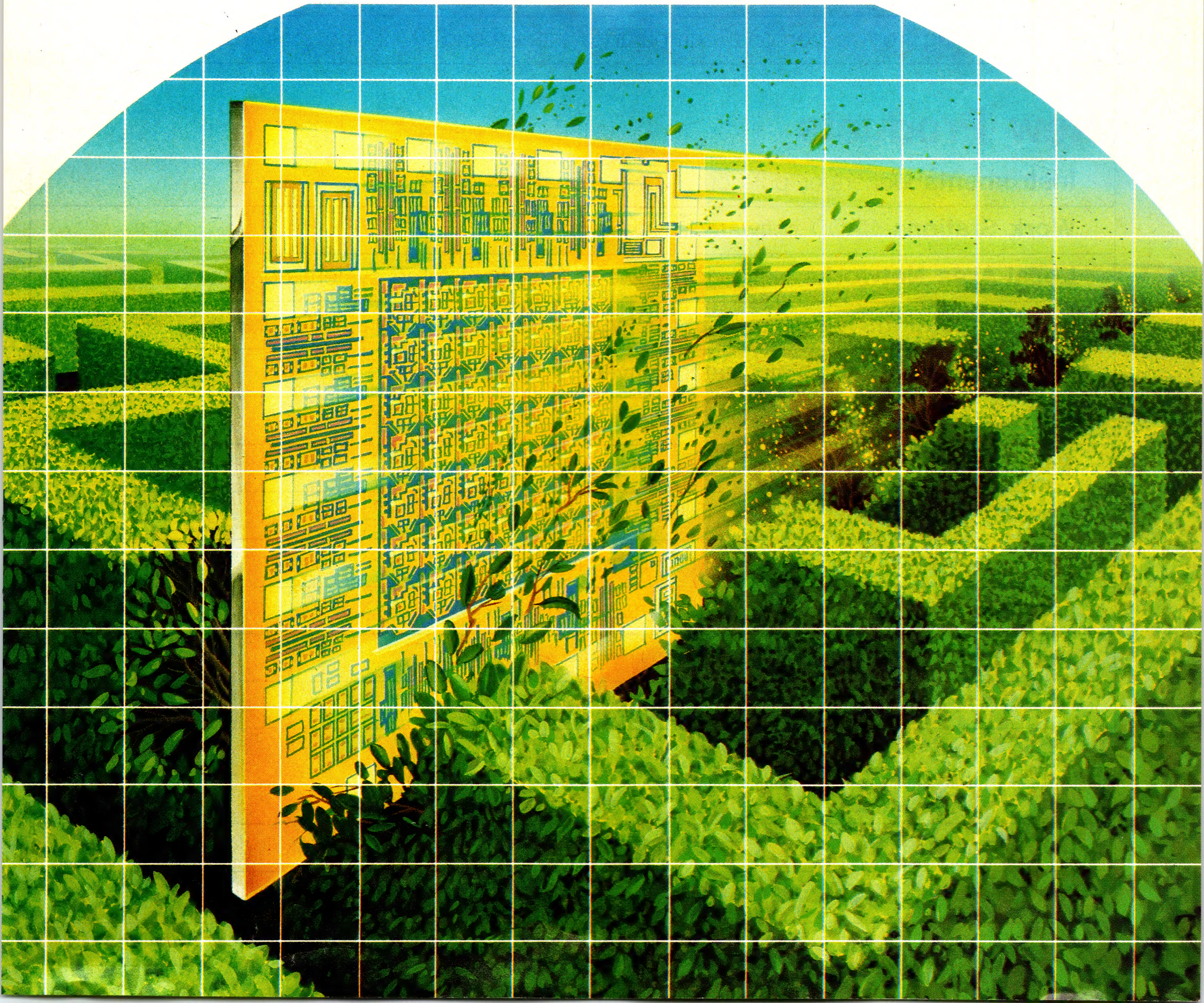

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In response to demands for more reliable systems with greater capability, system designers are integrating ROM-based software packages and microprocessors, strengthening the interaction of hardware and software **61**

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Uses for wireless infrared keyboards grow daily. They will soon be seen on everything from a personal computer to the second TV in the kids' room **71**

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Microsoft seeks to dominate microcomputer network strategies

With its introduction of a networking extension to its MS-DOS operating system, Microsoft Corp., Bellevue, Wash., seems ready to set the standard for microcomputer networking architectures in much the same way it dominated personal computer software with MS-DOS. The new software, Microsoft Networks, runs on the single-tasking MS-DOS 3.1 and requires a dedicated file server. Its strength, however, is its ability to insulate the software package from the networking hardware. Thus the same programs can be run on a variety of networks—from a bus approach on coaxial cable to a ring network on twisted-pair cabling. Microsoft Networks was developed in conjunction with IBM Corp. and Intel Corp. and has the same core protocols as IBM's previously announced PC Network. Besides IBM, the Microsoft package has the support of Hewlett-Packard, Digital Equipment, and Texas Instruments.

Unisoft to adapt Unix for Motorola, Signetics 32-bit chips

Unisoft Systems, a Berkeley, Calif., software firm that specializes in Unix ports, will put the operating system on the Motorola Inc. 68020 32-bit microprocessor and on a rival memory-management chip for the 68020 made by Signetics Corp. Unisoft will also port Unix to the Motorola memory-management chip and to its floating-point processor. Signetics, which is trying to gain a share of the 32-bit market with its complex Memory Access Controller [*ElectronicsWeek,* Aug. 27, 1984, p. 24] promises a prototyping chip by the first quarter of 1985; the MAC will not be available until the second quarter. The Motorola memory-management chip will not hit the market until the third quarter. Unisoft uses its own version of the Bell System V.

MCC opens new packaging and interconnection facility

Industry research consortium Microelectronics and Computer Technology Inc. in Austin, Texas, officially opened its semiconductor packaging and interconnection laboratory last week with plans to develop a new technology that eventually would reduce 64-bit supercomputers to the size of personal computers. Nine U.S. electronics firms are sponsoring the packaging research, being conducted in the new 21,000-ft^2 facility. By the end of the year, MCC officials expect a dozen companies to be backing the program. Pursuing new technologies through a series of "cascading development programs," the lab first plans to develop high-density, high-lead-count tape automated bonding for integrated circuits containing over 200 leads. That technology is slated to be transferred in early 1986 to the sponsors. Close on the heels of TAB will come advanced substrate and next-generation manufacturing technologies.

AMD enters battle for Ethernet controller chips

After nearly a year as the leading vendor of an Ethernet controller chip, Intel Corp., Santa Clara, Calif., now has competition from Advanced Micro Devices Inc., Sunnyvale, Calif. AMD has brought out a rival Ethernet chip set, designed in cooperation with Mostek Corp., Carrollton, Texas, and Digital Equipment Corp., Maynard, Mass. Mostek also promises to have the chip set in production quantities by the first quarter of 1985. AMD and Intel have a technology-exchange agreement, but the Ethernet project got under way before that agreement was signed. The chip was designed by Mostek, but AMD has apparently been able to build it first.

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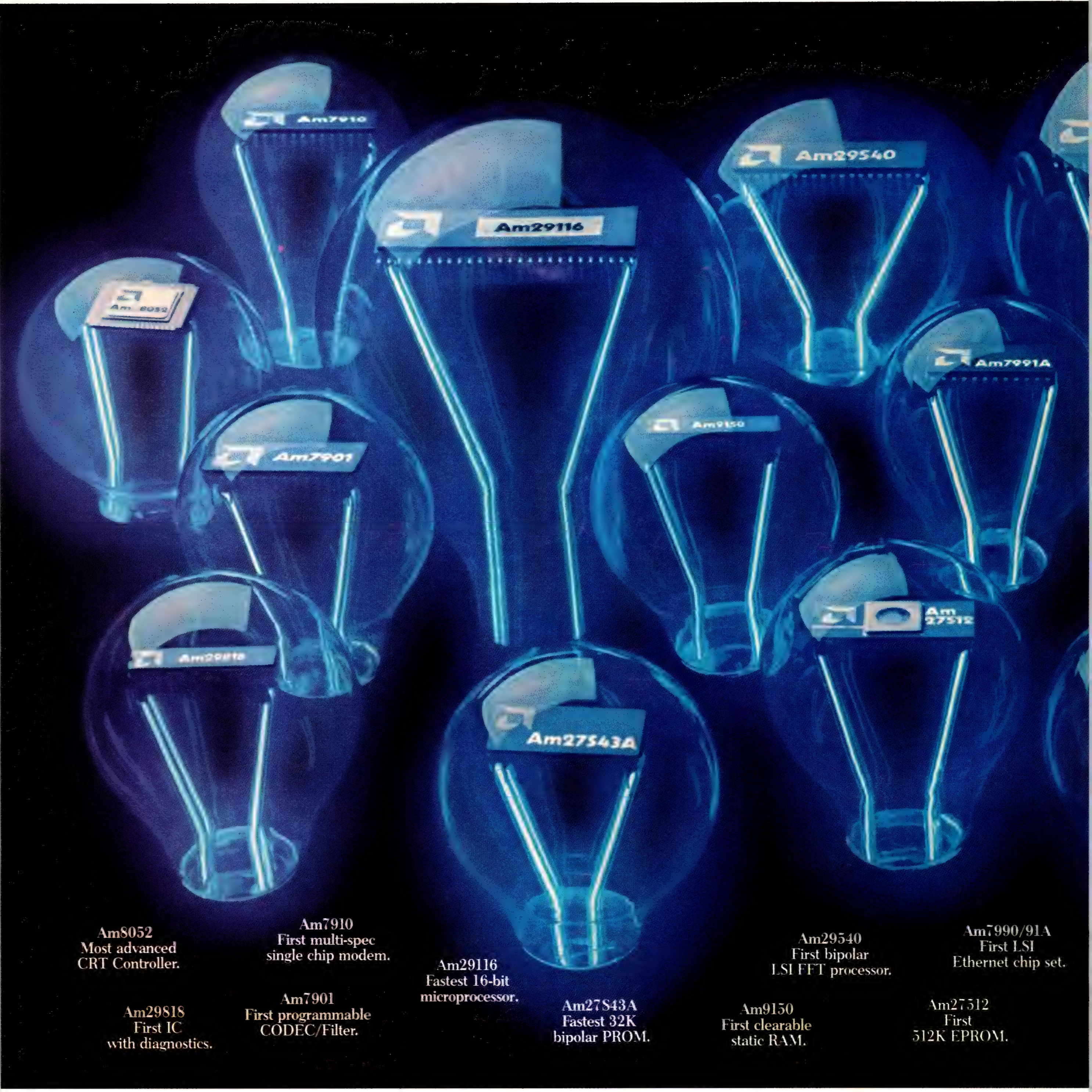

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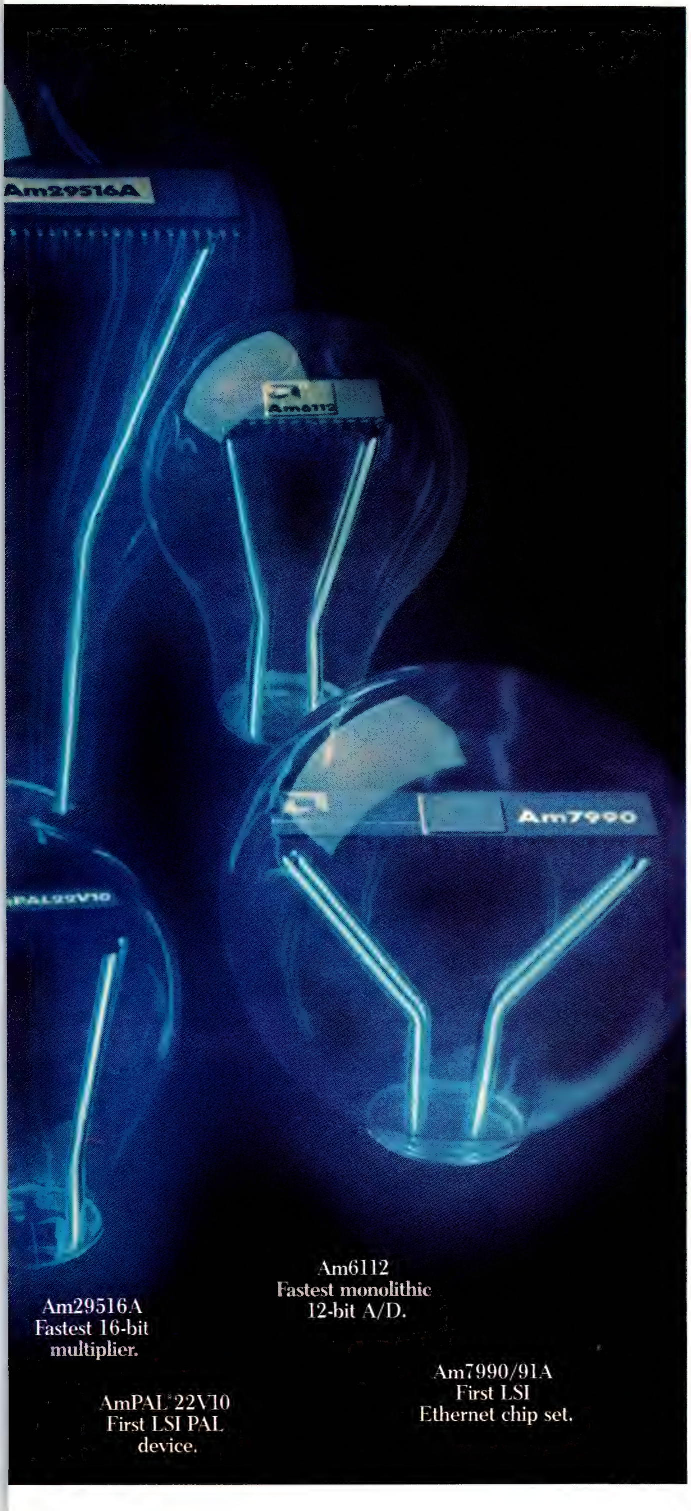

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Meetings

Com-Struct '85, Slater Publications Inc. (Com-Struct '85, 163 Highland Ave., Needham Heights, Mass. 02194), Bayside Exposition Center, Boston, Jan. 8-10.

IC Assembly Automation Conference, Intem Show Management (Malka Nagel, Intem Show Management, P.O. Box 390207, Mountain View, Calif. 94039), Le Baron Hotel, San Jose, Calif., Jan. 9-10.

Telecommunications for Pacific Development: Toward a Digital World, Pacific Telecommunications Council (1110 University Ave., Suite 308, Honolulu, Hawaii 96826), Sheraton-Waikiki Hotel, Honolulu, Jan. 13-16.

Advances in Display Technology V, Society of Photo-Optical Instrumentation Engineers (SPIE, P.O. Box 10, Bellingham, Wash. 98227-0010), Los Angeles Marriott Hotel, Los Angeles, Jan. 20-25.

Advanced Semiconductor Equipment Exposition & Technical Conference, Cartlidge & Associates Inc. (Joyce Estill, Cartlidge & Associates Inc., 1101 South Winchester Blvd., #M259, San Jose, Calif. 95128), San Jose Convention Center, Jan. 22-24.

Third International Modal Analysis Conference, International Society for Modal Testing and Analysis and Union College (Peter B. Juhl, Union College, Graduate and Continuing Studies, 1 Union Ave., Schenectady, N.Y. 12308), Orlando Marriott Inn, Orlando, Fla., Jan. 28-31.

Communication Networks Conference & Exposition, Conference Management Group (CW/Conference Management Group, 375 Cochituate Rd., Box 880, Framingham, Mass. 01701), Washington Convention Center, Washington, Jan. 28-31.

Industrial Productivity Conference and Exposition, Society of Manufacturing Engineers (1 SME Dr., Dearborn, Mich. 48121), Expo Centre, Orlando, Fla., Jan. 29-31.

Micro-Computer '85, Messe Frankfurt Ltd. (Philippe Hans, German American Chamber of Commerce, 666 Fifth Ave., New York, N.Y. 10103), Frankfurt Fairgrounds, Jan. 29-Feb. 3.

Aerospace Applications Conference, IEEE (Russell Gaspari, Hughes Aircraft, MS S12/W315, P.O. Box 92919, Los Angeles, Calif. 90009), Snowmass, Colorado, Feb. 2-9.

1985 Office Automation Conference, American Federation of Information Processing Societies Inc. (1899 Preston White Dr., Reston, Va. 22091), Georgia World Congress Center, Atlanta, Feb. 4-6.

Fourth Middle East Communication Show, Kallman Associates (5 Maple Ct., Ridgewood, N.J. 07450), Bahrain, Feb. 4-7.

Mini/Micro West, IEEE and ERA (Electronic Conventions Management Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045), Anaheim Hilton Exposition Center, Anaheim, Calif., Feb. 5-7.

Stride Faire '85, Stride Micro (4905 Energy Way, Reno, Nev. 89502), MGM Grand Hotel, Reno, Nev., Feb. 8-10.

Optical Fiber Communication Conference, IEEE (Optical Society of America, 1816 Jefferson Place N.W., Washington, D.C. 20036), San Diego, Feb. 11-13.

Seminars

Business Graphics, Frost & Sullivan Inc. (Wendy Engelberg, Frost & Sullivan Inc., 106 Fulton St., New York, N.Y. 10038), Cathedral Hill Hotel, San Francisco, Dec. 20-21.

International Solid-State Circuits Conference, IEEE (345 E. 47 St., New York, N.Y. 10017), New York Hilton, New York, Feb. 13-15.

Third National Credit Committee Meeting, EIA (2001 Eye St. N.W., Washington, D.C. 20006), Marriott Hotel and Marina, Ft. Lauderdale, Fla., Feb. 13-15.

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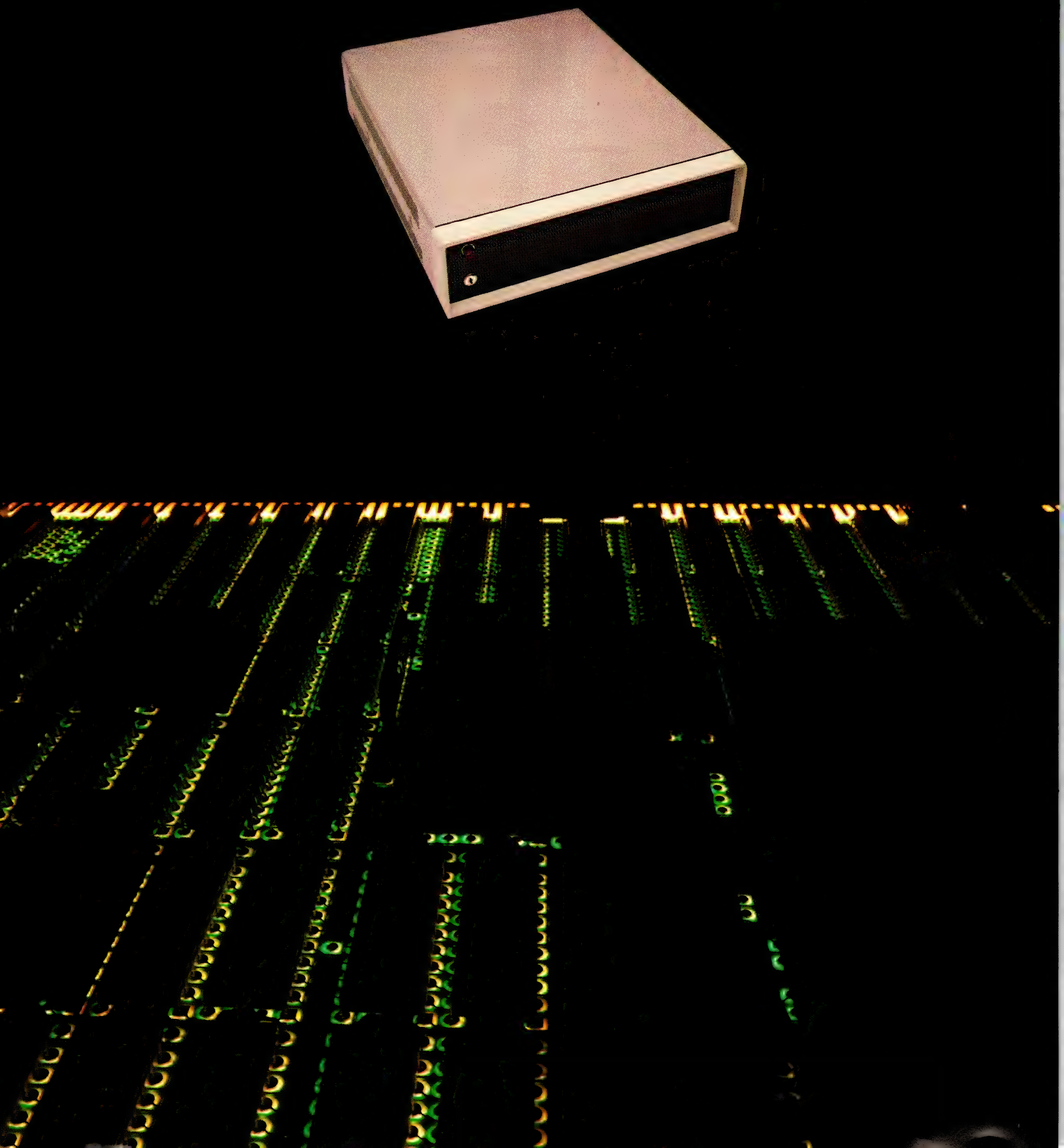

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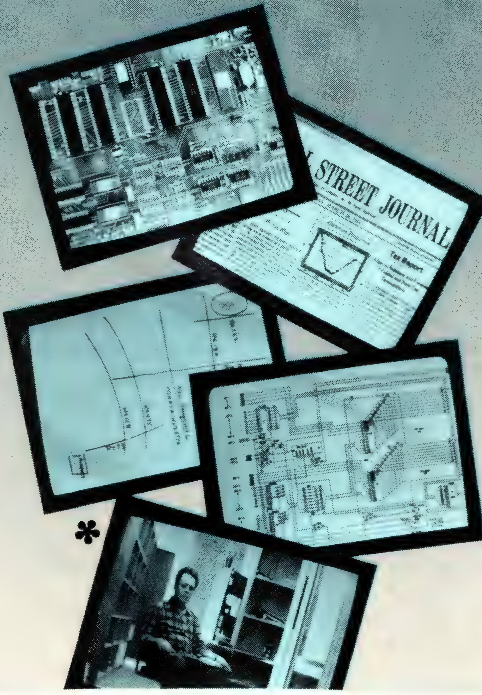

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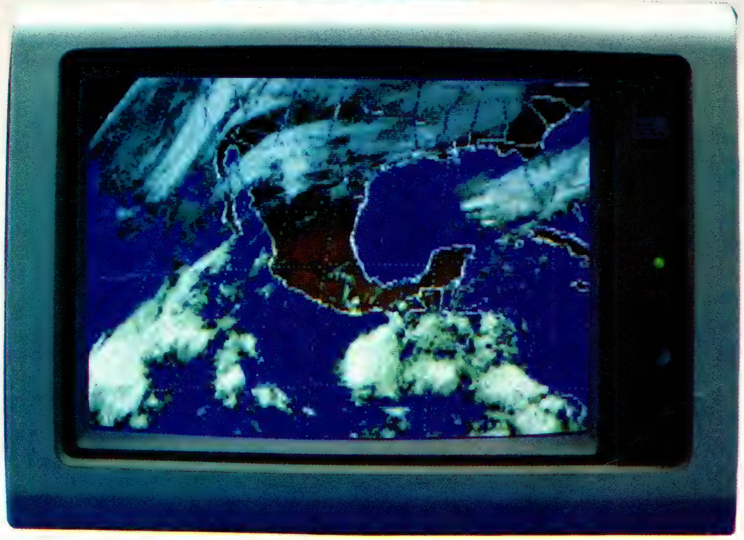

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AROUND THE WORLD

NEW CMOS CHIP PROCESSES DATA IN PARALLEL

Developed by NCR Corp., systolic-array part uses 72 1-bit processors and is aimed at image-processing applications

☐ *By Wesley R. Iversen*

Fort Collins, Colo.

The idea of processing data in parallel with arrays of computers working simultaneously on the same task has been kicking around industry and university laboratories for years. Its charm is that it would overcome the bottlenecks associated with conventional von Neumann-type serial-processing architectures.

Now NCR Corp., working with Martin Marietta Aerospace, Orlando, Fla., is bringing the concept to market with a part that integrates 72 individual 1-bit processors—each with its own 128 bits of memory—on the same CMOS silicon chip.

The part, which is being called the Geometric Arithmetic Parallel Processor (GAPP), integrates what is known as a systolic array. It is a radical departure from conventional chip-processor designs, which have concentrated on increasing the complexity of a single processor for more functionality and wider word-handling capability.

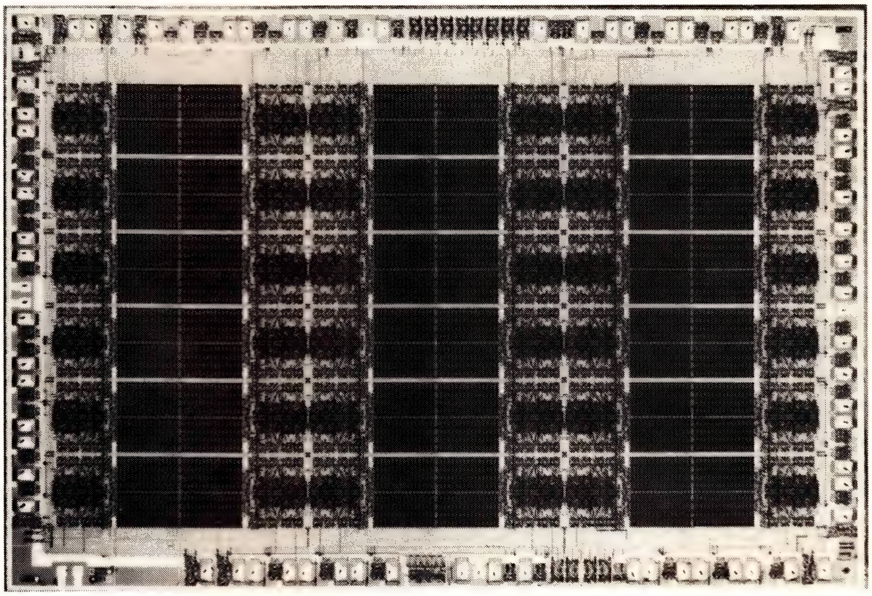
Image-processing use. For its targeted applications in high-speed image processing—which includes robot vision and automated inspection—the GAPP turns in some impressive performance specifications. Indeed, when running at 10-MHz, each GAPP chip can perform 8-bit additions at a rate of 28 million operations per second, claims Paul A. Sullivan, director of digital-signal-processing products for NCR's Microelectronics Division here.

That rate increases linearly as GAPP chips are cascaded together. Two chips working concurrently would perform 56 million adds every second, and so on, and any theoretical number of chips could be used for extending an array.

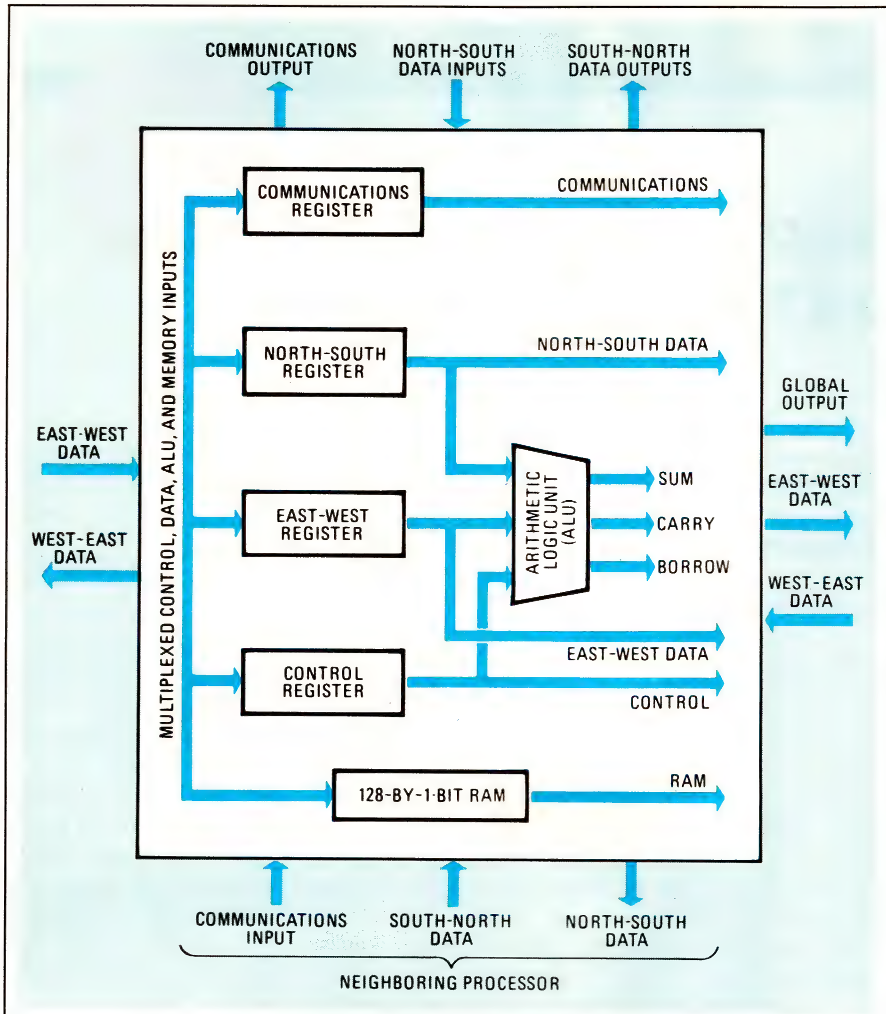
For demonstration purposes, a Multibus card that incorporates 32 of the chips has been assembled. The result is a card that runs at nearly 900 million operations (8-bit adds) per second. "That's about 100 times faster than the next-best Multibus board that you can buy on the market," notes Wyndham Hannaway, a consultant in Boulder, Colo., who has been working with the GAPP under contract to NCR.

Size and power improvements are also impressive. A laboratory system using GAPP chips developed by Martin Marietta requires only about 15 boards to do the same image-processing task that requires about 100 boards using conventional pipeline processing techniques. What's more, the GAPP-based system could run about four to five times faster, if necessary, while the conventional 100-board system is at its full capacity. Power requirements using the GAPP are likewise expected to be about six times less than with conventional military systems.

The GAPP owes its performance to its use of a systolic-array architecture of the kind first described in 1978 by H.T. Kung at Carnegie-Mellon University, Pittsburgh [*Electronics,* Oct. 20, 1982, p. 176]. Unlike



Creative. NCR Corp.'s new device, which integrates 72 individual 1-bit processors (each with its own 128 bits of memory) on the same CMOS chip, offers impressive size and power gains.



Radical. NCR's Geometric Arithmetic Parallel Processor, which integrates what is known as a systolic array, is a radical departure from conventional processor designs.

conventional processors, which move data one value at a time through a single processing element, a systolic architecture pumps data through an array of simple, highly regular processing cells, in much the same way that the heart circulates blood through the body.

Since each of the processors works concurrently with its own local memory, throughput is significantly increased. Traditional single-instruction, single-data machines are limited by processor-memory bandwidth.

In the GAPP design, each of 72 single-bit processor cells (laid out in a 6-by-12 array) contains an arithmetic logic unit, 128 bits of random-access memory, various latches, and bidirectional communications lines connected to its four nearest neighbors. Instructions can be globally broadcast to each processor in the array during every 100-ns cycle by way of 13 control lines and seven memory-address lines.

The chip can be used in a pure systolic mode in which parallel streams of data are input at one edge of the array and pumped through the processors to outputs on the other edge. An added feature is what NCR calls the CM (for communication) bus. This bus is linked to each cell on the chip so that data can be loaded or extracted from any processor in the array without interfering with ongoing processor computation or interprocessor communication.

Martin Marietta devised the GAPP architectural approach and will retain exclusive rights to its use in military applications. NCR, which designed the chip and funded the project jointly with Martin Marietta over the past two years, has rights to market the chip for commercial and industrial applications.

Samples available. The first fully functional versions of the GAPP were sent to Martin Marietta in July, Sullivan says, and sample quantities of the chip are currently available to other firms for nonmilitary uses. NCR will be fabricating the chip, which integrates about 80,000 devices on a 100,000-mil^2 die, here, using 3-μm double-level-metal CMOS technology.

The commercial version of the GAPP, the NCR45CG72, is available in an 84-pin ceramic pin-grid-array package priced at $545 each in quantities of 1 to 24. A version in an 84-lead plastic J-lead chip carrier sells for $495 each in like quantities.

COMMUNICATIONS

FCC SEEKS ROLE CHANGE

Washington—In its most significant move to free broadcast technology from government regulation, the Federal Communications Commission is getting out of the business of setting technical standards and deferring that role to the marketplace. Furthermore, the agency will strike a whole slew of existing standards defining the quality of radio and television signals from the books.

The action, disclosed last week, spells out the FCC's position on Docket 83-114, a notice of proposed rule changes issued earlier this year calling for the timely deletion or relaxation of as many restrictive broadcast standards as possible. According to its architect, Michael Marcus, chief of the agency's Technical Analysis Division, the new policy affects four categories of standards: quality, interoperability of equipment and systems, spectrum efficiency, and interference control.

Regarding quality, the FCC will initially scratch regulations pertaining to monaural AM, FM, and some aspects of TV service. Parameters defining acceptable distortion levels and frequency responses of aural TV and radio signals will be eliminated.

On the visual side, linearity requirements for TV transmissions will be dropped. In the second round, the agency will go after rules on AM and FM stereo separation and NTSC standards, which Marcus thinks have been cast in too much microscopic detail. Eventually, every service and the quality norms that accompany it will be reviewed, deleted, or simplified, he reports.

Still important. Interoperability standards ensure that different manufacturers' equipment will work together. These standards will be FCC-mandated in cases where public safety is at stake or when nationwide use of a service has been enunciated as federal policy—for example, to make sure that police departments can communicate with each other.

But for the most part, the FCC will rely on voluntary industry committees to set interoperability standards. The furthest it will go is to endorse a voluntary industry recommendation, such as the single-system dbx-Zenith transmission standard promulgated for stereo TV by the Electronic Industries Association.

While spectrum efficiency is an essential FCC goal, until now the commission has not used technical standards to promote it. Under the new policy, rules specifying the end result of spectrum use will be issued to urge licensees to adopt the most efficient technologies available.

For example, instead of authorizing a particular technology, such as amplitude-compandored single-sideband modulation for land mobile radio, the FCC will tell users that their equipment must produce a certain number of bits per second per hertz or a certain number of voice channels per megahertz, Marcus says. Such technologies as ACSB, packet radio, and linear predictive coding should quickly penetrate the market once those rules are in place, he believes.

Prime concern. Protecting operators from harmful interference was one of the prime reasons the FCC was created. Thus the commission does not propose to relinquish its role as an interference traffic cop. But it will examine alternative approaches in lieu of requiring the establishment of a new body of interference parameters every time a licensee wants to do something new.

Since the FCC has been steaming ahead with technical deregulation for years, communications equipment makers were neither surprised nor alarmed to learn of the new doctrine. "We expect very little impact on our industry," says W. Thomas Collins, a vice president with RCA Consumer Electronics in Indianapolis.

Citing a reason also advanced by the FCC, Collins says the deletion of standards will not cause broadcasters or manufacturers to change their habits, because any perceivable deterioration in quality and performance would show up in profit margins.

Private groups better. "Practically speaking, we don't need the FCC to address standards issues for new services either," he added. There are several private standards bodies that can fill the gap and do a better job, he contends. "The only downside is that FCC standards have been traditionally used as guideposts by systems designers to maintain the quality of broadcast equipment."

But the National Association of Broadcasters, representing some 4,500 radio and 700 television stations, is not convinced that service quality won't erode. While in full support of getting rid of rules that have outlived their time, the NAB says the FCC policy is only going to work where competition is strong enough to keep broadcasters investing in the best equipment available.

Criticism. In small markets, where only a handful of radio and TV stations reign, "there will be an incentive to trade away quality for cost in order to drive up revenues," claims Ralph Justus, an NAB staff engineer. Not subject to the competitive pressures that turn quality into a marketing tool, these operators may opt for the lowest-cost solution, he predicts.

Nevertheless, the FCC has faith that laissez-faire economics will ultimately triumph over all. "No matter how you look at it, the Darwinism of consumers voting with their channel selectors is a lot more effective and efficient than anything the government could ever do," maintains the FCC's Marcus. **–Karen Berney**

MICROPROCESSORS

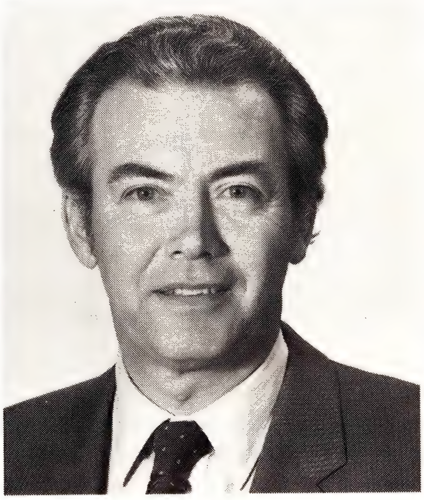
32-BIT CHIP INTEGRATES BIT-SLICE FUNCTIONS

Sunnyvale, Calif.—Bipolar bit-slice microprocessors with cycle times below 100 ns are regularly used in high-performance graphics controllers and signal processors where MOS circuits aren't fast enough. Advanced Micro Devices Inc., which just about owns the bipolar bit-slice market with its 4-bit 2901 family and its 16-bit 29116 controller, will soon begin sampling the first member of the first full 32-bit bipolar microprocessor family.

Designers of high-performance systems have been able to build 32-bit processors by customizing gate arrays or by stacking eight of the 2901 bit-slice chips. With the new family, however, AMD has partitioned the chips: functions that were contained in part on each 4-bit chip are now collected on separate chips.

Succession. First out of the box is the Am29325, a floating-point processor that can perform any operation in a single clock cycle. Measuring 130,000 mil^2, which AMD says is the largest bipolar chip made, it will be available next January.

Following at intervals over the next eight months will be a four-port



High performance. R. Clive Ghest stresses desktop applications for AMD's bit-slice technology. CAD work stations are one.

register file, organized as 64 words by 16 bits; a microprogram sequencer; a 32-bit arithmetic logic unit; and a 32-by-32-bit fixed-point multiplier for signal-processing applications and pattern recognition.

Parts of each of these are contained on the 2901 chips. The 32-bit family "will be useful anywhere 32-bit MOS doesn't have enough performance and the user doesn't want to buy a minicomputer," says AMD's vice president for product planning, R. Clive Ghest. Ghest sees applications in high-speed graphics and mass memory controllers as well as in high-performance work stations.

Variety. The chip set comes in two flavors, TTL and emitter-coupled logic, with cycle times of 100 ns and 50 ns, respectively. In the work station environment, Ghest says, they deliver 5 to 10 times the performance of a MOS processor. AMD uses a proprietary ion-implanted oxide-isolated process with three-layer metal interconnections. Even the chips with TTL outputs use ECL internally for high speed.

In addition, Ghest says, the architecture of the arithmetic logic unit supports high performance by executing many operations in parallel. As with the reduced-instruction-set computer architecture, it has the ability to perform simple instructions in short order.

The bipolar performance does not come free. It takes three chips—the sequencer, the register file, and the ALU or the floating-point chip—to perform the function of the single MOS central processor. The entire five-piece chip set will sell for several hundred dollars.

Nevertheless, maintains Ghest, it is still in the same ballpark as its high-performance alternative, ECL and high-performance gate arrays. A 32-by-32 bit multiplier would require far more packages and pins in a gate array. **–Clifford Barney**

MILITARY

CHIP MAKERS READY FOR VHSIC PHASE 2

Washington—The three contractors selected in late October for phase 2 of the Pentagon's Very High-Speed Integrated Circuits program are mustering their troops for design and production of microcircuits with minimum feature sizes of 0.5 μm, clock rates of 100 MHz, and circuit complexities in excess of 100,000 logic gates per chip.

While acknowledging the technological challenges ahead, Honeywell, IBM, and TRW say they are prepared to meet the stringent requirements that the Defense Department will impose as the technology that came out of phase 1 undergoes enhancement.

IBM Corp.'s Federal Systems Division, Manassas, Va., which last May became the first contractor to demonstrate phase 1 chips in action, was awarded a $50 million contract by the U.S. Army Electronics Research and Development Command. For the money, IBM will develop a set of 0.5-μm feature size CMOS chips to implement modular, ultrahigh-speed systolic processors with architectures flexible enough to handle the signal-processing requirements for acoustic array beam-forming, radar, electronic warfare, and image processing.

No cakewalk. "It will be no cakewalk to satisfy DOD requirements," stresses William Gianopulos, director of VLSI systems at the division. Successful VHSIC 2 development represents a quantum leap in military capabilities, he adds, noting that never before have such densities been applied to military systems. IBM is focusing on signal-processing applications, particularly the demonstration of a sonar signal-processing brassboard, which is called for at the end of the contract. That capability will let "DOD see and hear at distances never before possible," Gianopulos predicts.

Honeywell Inc.'s Solid State Electronics Division, Minneapolis, received a $65 million contract from the Air Force's Wright Aeronautical Laboratory to design, fabricate, and test integrated circuits with bipolar current-mode-logic technology for application in electro-optical signal processors. Motorola Corp.'s Bipolar Integrated Circuits Group, Phoenix, Ariz., will serve as a subcontractor and second source for the Honeywell chip designs, the DOD says. Honeywell, General Electric Co.'s Ceramics Division, and the 3M Co.'s Electronics Division will jointly develop multichip packaging for the submicrometer chips.

Interface chip first. Dallas D. Burns, director of VHSIC programs at Honeywell, says the first pass at producing a fully functional chip will be two years into the contract. The first chip, one of three major types Honeywell will develop, will be a bus interface. For it, Honeywell envisions a complexity level about equal to its phase 1 chips—which ranged from 121,000 to 142,000 devices.

Burns provided few details on the other phase 2 chips—called configurable chips because they can be personalized by changing the last few metal layers—but did say that they will be considerably more complex than the bus interface chip. Honeywell relied on 10:1 direct-step-on-wafer technology in phase 1 but will make use of electron-beam lithography in phase 2.

As for computer-aided design tools, Burns adds, Honeywell's major thrust will be "the integration of current tools developed under phase 1, which will be enhanced to accommodate half-micron complexities." Honeywell will incorporate the VHDL (VHSIC hardware-description language) into its system [*ElectronicsWeek,* Sept. 3, 1984, p. 17].

The third phase 2 contract, for $60 million, was awarded to TRW Inc.'s Electronic Systems Group, Redondo Beach, Calif., by the Naval Electronic Systems Command. The pact calls for a minimum of three chip types: a 32-bit signal processor, a mass memory, and a convoluter-convolver.

But TRW also proposed three other chip types—which are of nearly equal interest, according to Fred L. Alexander, manager of VHSIC programs. One was nothing less than a complete 32-bit mainframe computer on a single superchip. The other two were an associative processor for artificial intelligence and a fast-Fourier-transform chip.

Alexander says that these chips could be picked up later for the VHSIC program. The brassboard, in which the contract chip set will be demonstrated, will be based on a cruise missile's self-protection electronic warfare requirements.

The major challenge facing TRW in phase 2 is taking 0.50-μm technology from the laboratory, where its feasibility is proven, and making it into something that can be implemented into a pilot production line, or "perfection of the process," says Alexander. TRW is working both with bulk CMOS and bipolar three-dimensional processes. TRW's success in demonstrating these at the 0.50-μm size was instrumental in its winning the contract, in his opinion.

Further performance hinges heavily on improvements in electron-beam equipment that can increase chip throughput to acceptable levels. This part of the program is being undertaken by Hughes Aircraft Co. and Perkin-Elmer Corp. TRW is teamed with Motorola's Semiconductor Products Sector, Phoenix, for chip design and fabrication tasks. In addition, General Dynamics Corp., Convair Division, San Diego, will participate as a system consultant.

Hanging in there. Several contract bidders not selected for phase 2—among them AT&T, Hughes Aircraft, Texas Instruments, and Westinghouse—believe there are alternatives to staying in front of VHSIC development, even though they are not getting direct DOD funding. Some hope to participate through second-source agreements required by the government of phase 2 contractors; others continue to look to alternative sources of funds for submicrometer technology development.

They also note that significant work—and business—remains with phase 1 technology. "VHSIC 1-class technology will be the mainstream technology well into the 1990s," says Ben Sloan, TI's VHSIC program manager. **–George Leopold**

Reporting for this article came from Karen Berney, Wesley R. Iversen, J. Robert Lineback, and Larry Waller.

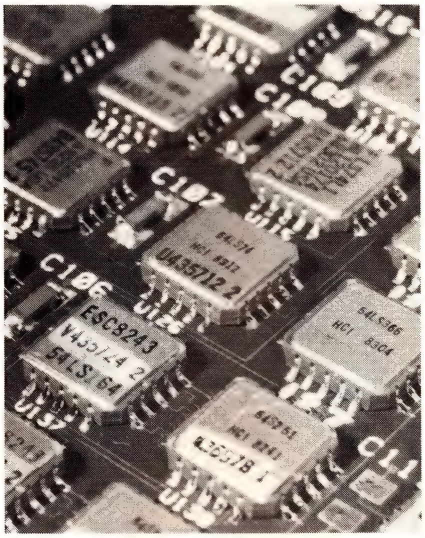
TESTING

SMDs POSE TEST WOES

Dallas—Almost everything is good about surface-mounted board assemblies—except the cost to test them. Understandably, then, considerable effort is underway to bring test costs into line, and those efforts came in for a lot of attention at the Automatic Test Equipment Central conference held here earlier this month.

The most obvious challenge, explained Steve Cook of Hewlett-Packard Co.'s Manufacturing Test Division, Loveland, Colo., is getting access to the test nodes, which lack the leads that are available with conventional devices. Testing surface-mounted devices having gull-wing leads is risky, since applying even slight force can temporarily close an open or bad solder joint and make it look good. In addition, the probe may slip off the steep joints and hit an adjacent trace or component, causing damage.

Perilous packages. Even harder to deal with, added Cook, are surface-mounted components in plastic and leadless chip carriers, whose solder joints are hidden under the package. Though probe modules are available to clip on to such packages, they are costly—at least 50% more than standard probes—and make contact on only one side of the device, letting solder faults escape detection.



Hard to test. Printed-circuit boards packed with SMDs pose serious testing problems.

Less obvious are the difficulties involved in designing test fixtures. For a conventional printed-circuit board, they are prepared from the tape used for drilling the holes for loading leaded components. Because surface-mounted devices need no mounting holes, such information is not available; a fixture drilling tape must evolve from cooperation between the design and test groups involved in the production process, Cook noted.

Probes present other problems as well. Those for 0.050-in. lead spacing are much more fragile than their standard 0.100-in. counterparts. They are also harder to install and wire, Cook explained. In addition, they require strain-relief provisions to avoid bent or fractured terminals.

Fuss over fixtures. Still another problem is the fixture complications resulting from loading surface-mounted devices on both sides of a pc board, which usually precludes having all test nodes on one side. A double-sided fixture is expensive, will probably require custom machinery for tall components, and may dictate a cooling system if the enclosed fixture traps too much heat dissipated from the board under test.

Cook has solutions in mind to ease the job of testing surface-mounted boards. They include adding test pads at least 0.032-in. in diameter along the traces on the board, and then spacing them on 0.100-in. centers so standard probes can be used. Bringing all test pads to one side of the pc board renders two-sided test fixtures unnecessary, too.

GenRad Inc. offers a solution, too, reported Sam Meshulam of the firm's Production Test Division, Concord, Mass. Its universal surface-mounted-component fixture system for in-circuit testing consists of a base unit with pneumatic cylinders, cam actuators, linear bearings, tester interface, probe-plate interface, covers, controls, and interchangeable probe plates designed and fabricated using GenRad's Digi Quick software-intensive fixture wiring service.

Even conventional fixtures cost more than the tester, and surface-mounted-device fixtures run still more, Meshulam reported. Typically, he explained, electronic manufacturers have to set up in-circuit tests for 5 to 10 new pc-board assemblies per year, with fixture costs totaling from $15,000 to $30,000.

Dedicated fixturing costs range from $15,000 to $25,000 each, so the total for 10 dedicated surface-mounted-device fixtures could cost $250,000, some eight times more than conventional fixtures. With a universal fixture such as offered by Gen Rad, Meshulam maintains, the cost multiple would drop to between two and four. –**Howard Bierman**

RADIO

FOOTBALL-HELMET RADIO TO BE TESTED BY NFL

Dallas—Conventional wisdom has it that the fervor of home-team gridiron fans inspires players to higher levels of performance. Maybe so, but the noise can also lead to missed snap counts and broken plays that stall drives to the goal line. As a result, the National Football League is considering the use of FM radio receivers mounted in football helmets so that offensive players can catch the counts of their quarterback no matter how loudly the crowd roars.

An experimental, low-power FM radio system, being developed by Telex Corp.'s Communications Division, Minneapolis, has been tested on the sidelines during preseason games. It is being considered for trial runs during game action in the 1985 season, says Tex Schramm, president of the Dallas Cowboys and chairman of the league's Competition Committee, which is expected to review the proposal in February before the league's annual meeting in March.

For those who design FM systems, the helmet-to-helmet communications system is a whole new ball game, says Donald Mereen, director of marketing for Telex Communications, which for the past three years has been supplying the transmitters that NFL referees use to announce penalties. "The technology is very similar, but the problem is primarily one of sizing and safety to both the people wearing the equipment and, of course, the equipment itself. It does get rather violent out there," notes Mereen, with a chuckle.

After the initial demonstration three months ago, several coaches and team leaders have asked Telex to push on with the design of a finished prototype, which is scheduled to be ready early next year. In addition, Telex has already received calls from rugby teams in Australia and hockey coaches in North America who are interested in the on-field system development.

ICs and hybrids. The system's technology—still in the definition stage—will be based around low-power integrated circuits and hybird components, says Mereen. Currently, the intent is to make the transmitter and receiver systems run off conventional 9-V batteries. The design goal is to have the units work over a distance of 50 to 75 yards. The quarterback's unit will have a transmitter and microphone built into the helmet. Small FM receivers will go into the other players' helmets, with tiny loudspeakers inside, just above the ear holes of the headgear.

The entire system will be packaged in two portions, says Mereen, with the battery compartment separate from the radio-frequency circuits. "Ignoring the battery compartment, I would say the basic receiver prototype is 3 in. by 1.5 in. and less than ½-in. deep. The quarterback's transmitter is slightly larger," he explains.

Telex declines to disclose the estimated cost of helmet rf systems, but Mereen indicates the basic microphone and receiver equipment (excluding amplification circuits) now runs $1,500 to $2,000. Integration and higher volumes could bring that cost down.

Under the proposal—first suggested by the Atlanta Falcons team and promoted by its vice president, Eddie LeBaron—the systems would be used only by the offense after players have lined up for the snap. Quarterbacks would switch on the FM transmitters when reaching the line of scrimmage. The transmitter would stay on for 20 to 30 seconds—just long enough to call out the signals for the snap. The system then would go dead until the next play.

"We have been working on something to allow players—especially on the visiting team—to hear the signals and audibles when the crowd noise is very high," explains LeBaron, adding that the Falcons once considered a voice-amplification system, but the

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electronics were too bulky.

Some NFL leaders are also suggesting a second phase to the radio-helmet concept that would allow coaches to transmit play selections to players as well as have quarterbacks communicate with players on passing routes 50 yards away. This would require using systems of different transmission frequencies for opposing players and possibly encryption techniques to protect play calls.

To Schramm, whose Cowboys pioneered the use of off-the-field computers for scouting and creation of game plans, the helmet-radio system could be the first crack in a 30-year NFL ban against the use of "electronic devices" on the field. The rule was instituted in the 1950s after then Cleveland Browns coach Paul Brown experimented with electronic transmission of plays to the offense from the sidelines. **–J. Robert Lineback**

MEMORIES

SIEMENS ENTERS 256-K DRAM RACE

Munich—By the rules of the worldwide memory game, it may seem a bit late for a company to enter the race for 256-K dynamic random-access memories. After all, most Japanese chip makers have been selling them for about a year, and U.S. firms are getting ready to do the same [*ElectronicsWeek,* Sept. 24, 1984, p. 22].

But for Siemens AG, that is no reason to throw in the towel. "It's never too late to enter a market with a quality product," asserts an executive at the German company's Components Group here. "Besides, it will be some time before the 256-K market reaches its peak years," he adds (see "Big chip, big market," right).

That, no doubt, is the reasoning behind the firm's heavy commitment to 256-K DRAM development and its plans to start volume production next spring at a new factory in Villach, Austria. Thus, Siemens will become Europe's first chip maker to mass-produce such parts.

To be introduced this week at the Electronica components show here, the chips are intended for the merchant market as well as for the company's own use. Volume shipments will start around mid-1985.

Siemens's DRAM has a 262,144-word-by-1-bit organization and integrates 320,000 transistors and 260,000 other elements on a 45-mm^2 chip. There will be two versions, the HYB41256 and the HYB41257, designed for the page mode and the nibble mode, respectively.

Each version will come in three speed classes to fulfill different data-rate requirements. The access time for the fastest part is 120 ns; then comes one rated at 150-ns, and finally one at 200 ns. The corresponding cycle times are 220, 260, and 300 ns. For the nibble mode on read and write cycles the access times are 30, 40, and 50 ns.

The 5-V-only component, which comes in an industry-standard 16-pin dual in-line package, uses 2-μm n-channel silicon gate technology, with tantalum polycide providing for high speeds. A proprietary cover protects the chip against alpha radiation. In operation, the device consumes 385 mW, and in standby 28 mW.

"The device combines several technical features which we believe give it a good competitive position on the market," says Hans J. Penzel, general manager for MOS operations at the Components Group. These features are a high-capacitance cell structure, a silicide gate technology, and laser-programmable redundancy. Also, it will be one of the first 256-K products to come in both ceramic and plastic packages at the outset.

High capacitance. The high-capacitance cell structure, with a 20-nm gate oxide thickness coupled with a deep boron implant, enhances the signal-to-noise ratio. The boron implant boosts the storage capacitance, improves cell isolation, and forms a reflecting barrier against diffusing electrons generated in the substrate by alpha-particle tracks.

In Siemens' silicide gate technology, a polycide stack is formed by sputtering a 200-nm tantalum silicide film on a phosphorus-doped 300-nm polysilicon layer. This arrangement, Penzel explains, increases the conductance of the bit lines by a factor

Big chip, big market

With its 256-K dynamic random-access memories, West Germany's Siemens AG is entering a market that is certain to become the biggest in volume for any single component made so far. Currently dominated by a number of Japanese producers, that market could climb to 200 million units next year and go to "between 600 million and 700 million units in 1986," says Hans J. Penzel, general manager for MOS operations at the Siemens Components Group in Munich. "We think a peak will be reached between 1989 and 1991 when 256-K DRAMs will be shipped at annual rates of more than 2 billion units worldwide," he says.

Meanwhile, not even 64-K DRAMs have reached their peak in volume. These, he adds, could crest between 1985 and 1986 when they will sell at an annual rate of between 1 billion and 1.5 billion units.

Penzel attributes the enormous growth for high-capacity DRAMs to three factors: the invention of the microprocessor, the rapid development of process technologies and production techniques, and the standardization of memory products. "The worldwide demand for dynamic memories in microprocessor-based systems already is bigger than that for DRAMs in mainframes," Penzel points out. So it is not surprising that producers of microprocessor-oriented systems are increasingly influencing the definition and specifications of new memory products, he says. "During the 256-K lifetime we expect a number of applications-oriented versions that may be used in video equipment, for example." **–J.G.**

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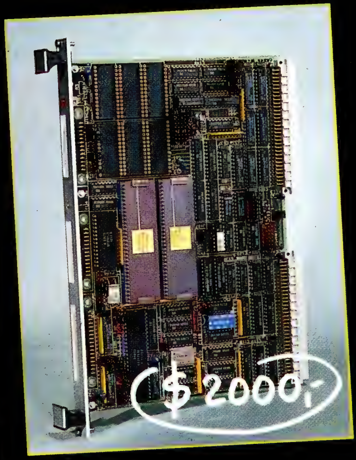
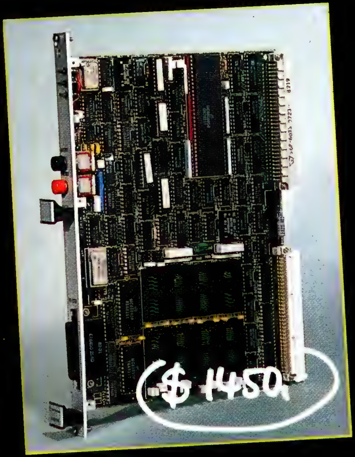
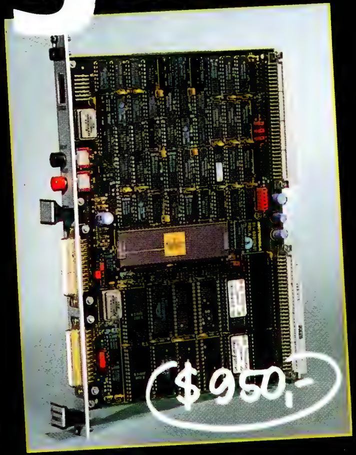


MVME115M
MC68010 with MMU



MVME110-1
MC68000 with I/O Channel



MVME101 MC68000
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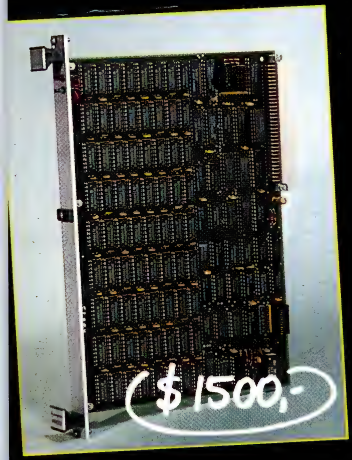

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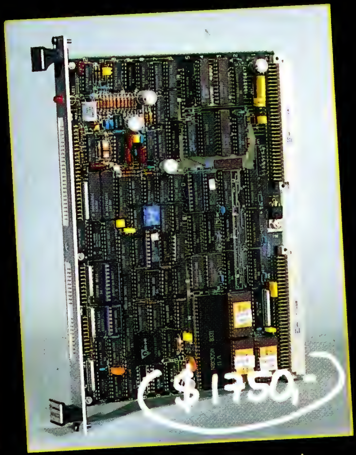

MVME320 Winchester and
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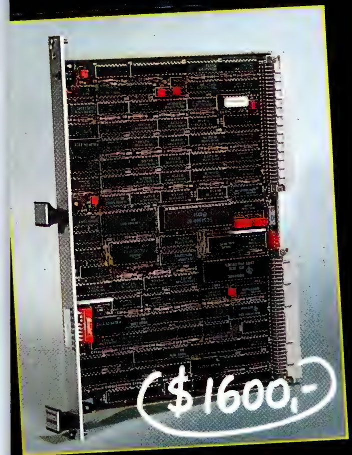

MVME300 IEEE-488
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MVME330 LAN
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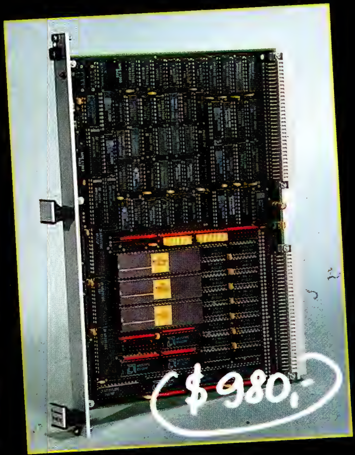

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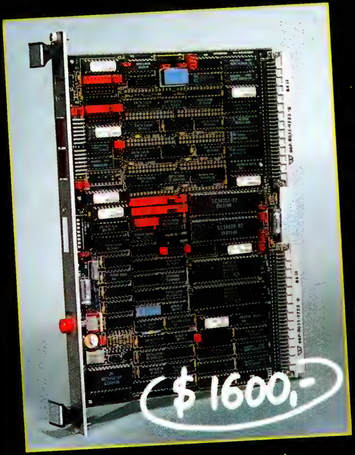

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M68K102B2	VME/10 microcomputer system with 15 Mbyte Winchester disk, 655 Kbyte floppy disk, 5-slot VMEbus backplane and 4-slot I/O channel backplane
M68K102C2	As M68K102B2 with 40 MB Winchester
Processor Modules	
MVME101	MC68000 with 256 KB on-board memory space, system controller functions, 1-level bus arbiter, VMEbus interface, parallel I/O, 2 serial I/O ports, timer
MVME110-1	MC68000 with 256 KB on-board memory space, 1-level bus arbiter, VMEbus interface, I/O channel interface, 1 serial I/O port, timer
MVME115M	MC68010 with MC68451 192 Kbytes on board memory
MVME120	MC68010, MC68451, 64 Kbytes ROM area. 128 Kbytes dual ported RAM, 4 Kbytes Cache
MVME121	As MVME120 but with 512 Kbytes RAM
MVME128	MC68010/MC68451, 256 Kbytes dual ported RAM VMXbus interface
Memory Modules	
MVME201	256 Kbytes dynamic RAM with parity
MVME202	512 Kbytes dynamic RAM with parity
MVME222-1	1 Mbyte dynamic RAM with parity
MVME222-2	2 Mbytes dynamic RAM with parity
MVME211	1 Mbyte static CMOS RAM/ROM/ EPROM module
System Controllers	
MVME025	VME system controller
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PRODUCT REFERENCE	DESCRIPTION
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MVME310	Universal intelligent Peripheral Controller (UIPC) with free user area
MVME315	Intelligent floppy disk controller and SASI/SCSI interface with DMA
MVME316	VMEbus to I/O channel adapter
MVME319	Floppy disk controller and SASI tape controller interface
MVME320	Winchester/Floppy disk controller
MVME330-UX	Ethernet controller module with UNIX S/W
MVME330-VX	Ethernet controller module with VERSAdos S/W
MVME331	6-Channel intelligent serial communications module
MVME333	4-Channel intelligent high speed communications module
MVME340	64-bit parallel interface module
Peripheral I/O (I/O Channel)	
MVME400	Dual-Channel serial I/O
MVME410	Dual-Channel 16-bit parallel I/O
MVME420	SASI peripheral adapter
MVME435	Buffered 9-track magnetic tape adapter
Industrial (I/O Channel)	
MVME600	16-Channel analog input
MVME601	16-Channel expansion for MVME600
MVME605	4-Channel analog input
MVME610	120V/240V 16-Channel AC input
MVME615	120V/240V 16-Channel AC output Zero cross-over switching
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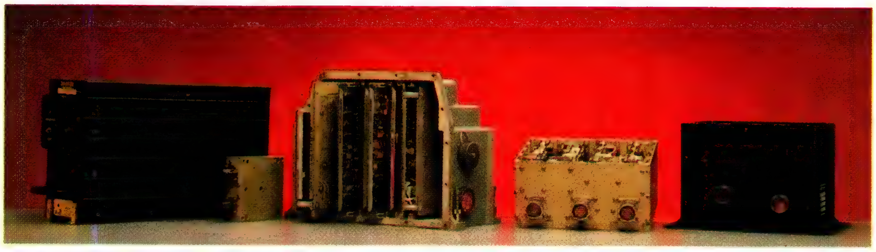

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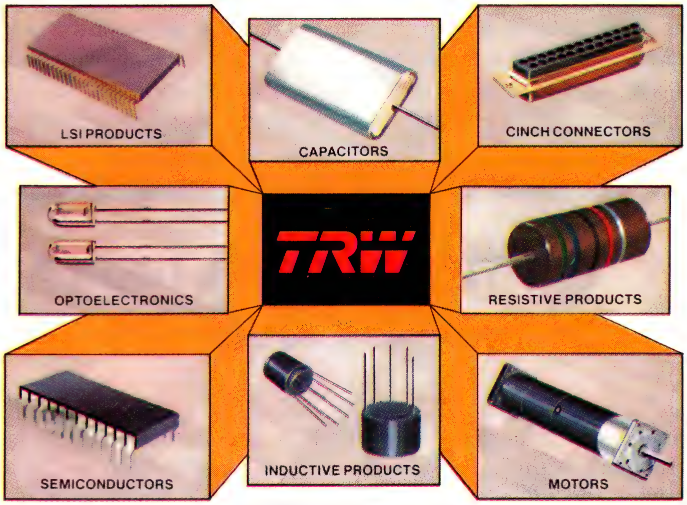

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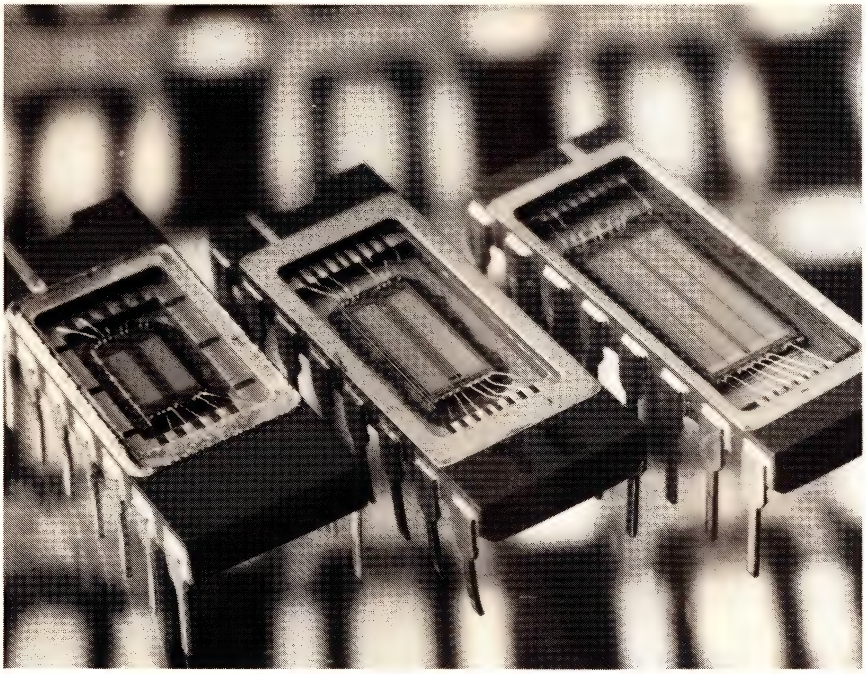


Versatile newcomer. Entering the race for 256-K DRAMs, Siemens is marketing two versions—designed for the page mode and the nibble mode—each with three speed classes.

of 10, improving performance.

For increased yield, the Siemens 256-K DRAMs utilize redundancy, provided for by eight spare rows and four spare column pairs on the chip. To activate this redundant circuitry, the company uses a laser pulse that opens polycide links within the spare row and spare column decoders.

In circuit operation, a high data rate is achieved in the nibble mode. In system operation, however, timing problems may arise for nibble cycles with minimum cycle parameters. So, as a new feature, the data output of the circuit is held in the valid condition from one nibble access to the next, which allows ample time for proper sensing with minimum cycle parameters. **–John Gosch**

AUTOMOTIVE

GM TESTS VIDEO DISPLAY IN 1984 PRODUCTION CAR

Baltimore—If tomorrow's cars will be crammed with electronics, Buick may have the jump on its competitors with its new in-dash touch-sensitive cathode-ray-tube terminal. A production-model 1984 Riviera is the vehicle the General Motors Corp. division here is using to demonstrate that the technology is feasible. And if current market tests pan out, Buick may revive plans to offer the display as an option to consumers next fall.

To be sure, the information and control functions of the first large-scale production-car CRT will be more modest than those touted for the automobile of the more distant future. Buick's plans do not include the navigation and telecommunications capabilities of its prototype Questor Electronic Concept Vehicle [*ElectronicsWeek*, Oct. 15, 1984, p. 57]. Indeed, functions have been limited to climate control, the audio system, and trip information.

A Motorola 6800 microprocessor customized by GM's Delco Electronics Division controls the various functions and accepts instructions from the driver. Road tests reveal that the display stays bright and resistant both to mechanical jolts from potholes and electromagnetic interference from overhead electric power lines and police radar.

Touch screen. When the ignition key is turned, the CRT lights up. To select a function, for example the radio, the driver touches the word Radio on the screen. Integrated membrane switches (supplied by Zenith Electronics Corp., Glenview, Ill.) below the panel respond to the pressure and display a digital tuner with preset AM and FM stations.

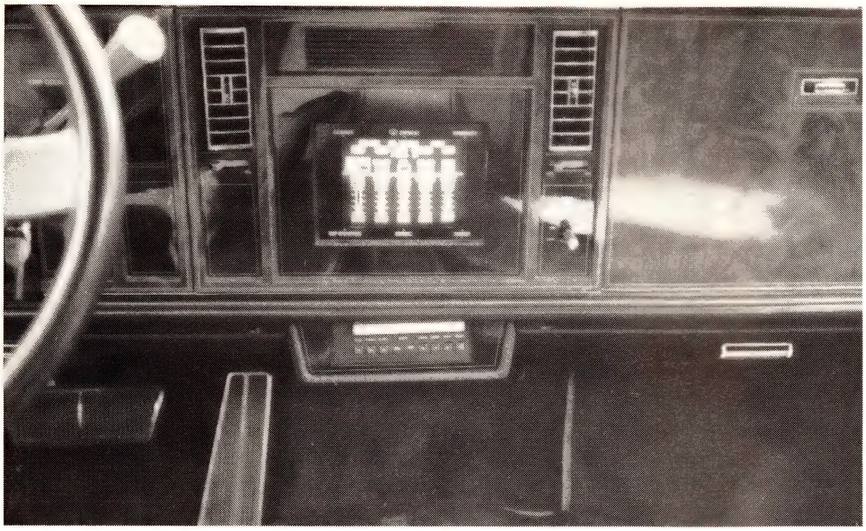
To select a station and control the volume, the driver touches the appropriate screen icons: volume up/down, tuner scan, or preset. By touching another icon the entire display changes to show a graphic equalizer, and changes again to illustrate how the speakers are balanced. All adjustments are made by touching the screen.

The driver programs the trip data in the same way—after supplying miles-to-destination, he will get back readings of elapsed time, average speed, estimated time of arrival, and fuel consumption. For climate control, the driver simply selects a desired temperature. There is a separate metric function to convert all measurements to kilometers, liters, and degrees Celsius.

According to Carey Wilson, CRT project chief for Buick Motor Division in Flint, Michigan, "the learning curve is easier with a CRT because the driver only has to contend with one functionality at a time." The display's documentation, however, takes up 44 pages in the driver's manual, and begins with a warning not to use it in heavy traffic where "complete driving concentration is required."

But there are those who argue that complete concentration is always required when one drives, and if a driver has to take his eyes off the road to work the radio or air conditioner he may miss, with severe consequences, important happenings outside. This is not the case with conventional instrumentation, where a driver can sense how far he has moved a knob or lever without actually looking at it.

Wilson admits that an absence of tactile feedback could present a problem. "In an updated system we may have to avoid changing screens to



Touch-screen CRT. This particular display shows a graphic equalizer. By touching other parts of the screen, the driver can display trip information or control the radio and air conditioning.

control each functionality and just display everything at once—even though the system might take longer to learn. We may also provide some kind of audio feedback [beyond the present system's beep tones] to inform the driver that his instructions have been carried out."

Eventually, Wilson predicts, a car could be outfitted with a head-up display (HUD) superimposed on the windshield, similar to those used today in military aircraft. "There's an awful lot of work on an automotive HUD going on at Delco. But it's still highly controversial from a human-factors standpoint in a passenger car," he says. The issue, ultimately, is managing information. Wilson points out that today's cars have features galore, "and it's up to the automaker to deliver them without a proliferation of buttons."

Ford and Chrysler. The other U.S. majors seem to share Wilson's perspective, at least in principle. Chrysler Corp. won't reveal its marketing plans, but Robert Heath, a company spokesman, said that dashboard CRTs are the way to go.

Ford Motor Co.'s Continental Mark VII will feature a CRT option "in early 1985," according to Leonard Groszek, technical planning manager for electronics. But in contrast to Buick, Ford does not plan a general production run for it. No price has been set, says Groszek, but initial production will be between 1,000 and 3,000 units, depending on how the market reacts.

Groszek is confident that in the long run, CRTs will become the dominant automotive display technology. "It's a much more flexible format than any other for adding information," he says. "Liquid-crystal or vacuum-fluorescent displays aren't matrix-addressable so it's harder to program them to accept new functions." **–David M. Weber**

COMPUTER GRAPHICS

SOFTWARE UPS PRODUCTIVITY FIVEFOLD

Martlesham, England—A picture may be worth a thousand words, but at British Telecom's Research Centre here, it is probably equivalent to as many lines of computer code. The software automation group is busy turning flowgraphs and other program specification diagrams directly into executable code with the help of a software package, SX1-Cados. Cados stands for Computer-Aided Design of Software, while SX1 is a reference to Essex University, Colchester, Essex, where the SX1 automatic programming package was first developed.

Away from Martlesham, Cados is getting British telephone exchanges to market faster. At 20 UK sites and one in the U.S., Cados software, running on Digital Equipment Corp. VAX computers, has increased programmer output fivefold, cut errors by 80%, produced better structured programs, and promptly delivered software documentation. Most of the software for one of Britain's fastest selling exchanges, the UXD 5 digital local exchange, was written with the help of Cados, as is the latest software for the big national exchange effort, System X.

Yet one snag remained. Flowcharts had to be manually translated into a VAX data-entry language. But a new graphics editor, running on an IBM Corp. Personal Computer, has removed this roadblock, and turns screen charts directly into VAX entry code. The software group, headed by Trevor J. Matthews, also has in the works a 68000-based work station that allows the user to interact with the full Cados system.

With the IBM PC-based editing package and a pointing device, a user can select boxes and other symbols from an on-screen menu to produce high-level flowgraphs, progression charts, and state transition diagrams (see "Charting the way to better software," p. 30), edit them, and, when he is satisifed with the result, generate both a printout and a text-entry code. The text-entry code can be transferred to a VAX/VMS-operating superminicomputer, where it will be converted into a high-level code such as Pascal or C.

Fancy package. Even fancier is a 68000-based software work station, due out in six months. It runs the full Cados SX1 software package under Unix, can directly convert diagrams into efficient high-level code, and has a one- to three-screen setup for showing software diagrams and text at different hierarchic levels.

With the new terminal, diagrams are drawn and changed with a pointing device and on-screen menu, as before. Some extra editing aids are added, however: symbols, such as boxes, expand to make room for added text, for example, and messy diagrams are automatically redrawn. And, as the drawing grows, the software sizes it to fit the screen.

Extended flowgraph. In this way, software specifications can be built up and modified on-screen. Several techniques can be used to visualize telecommunications software. One technique, used at British Telecom, is the extended flowgraph.

High-level flowgraphs show broad program structure, revealing how low-level software modules are linked together. Meanwhile, low-level flowgraphs show the detailed algorithms within a module and comprise high-level-language-like statements. The SX1 program generator automatically handles the full hierarchy of charts, linking the generated code into a complete executable program. The work station supports PL/M, Pascal, C, and Coral, the real-time language used by the British Ministry of Defence.

Other developments in the works include support for SDI, the International Telegraph and Telephone Consultative Committee's specification and description language. The work station will later incorporate debugging, testing, and emulation facilities at the diagram level. A data dictionary will also be added, as will comprehensive error checking across a suite of diagrams. Eventually, the Cados work station could be incorporated into a fully integrated programming-support environment under development at British Telecom.

Though the Cados SX1 system is primarily intended for developing telecommunications software, it can be used in any application where pictorial methods of specifying software are useful. This includes process control, man-machine interfaces, and office automation. **–Kevin Smith**

Charting the way to better software

Computer software for telecommunications, process control, and other real-time applications are often best represented pictorially. When a telephone handset is picked up, for example, the action triggers the exchange to send messages to any controlled hardware or software subsystem. The precise sequence of events, as the exchange switches from one state to another, is more clearly shown in diagram form rather than as a text list. A variety of techniques—flowgraphs, progression charts, and state transition diagrams—are used for this purpose.

But increasingly, software to control modern telephone systems is being specified in SDL, or Specification and Description Language. This is a powerful language developed by the International Telegraph and Telephone Consultative Committee (CCITT). High-level flowgraphs, developed earlier at British Telecom, perform a similar function.

The basic idea behind Cados is to automatically generate high-level code from such graphical specification languages. Of course, simple flowgraphs just do not contain enough information to generate code automatically. But additional instructions, such as high-level data-handling statements, decision tables, and the like, can be added to the basic flowgraph.

The system analyzes the overall structure of the chart, produces code to represent this structure, incorporates code derived from different symbols and encodes lower level charts as they are referenced. Then it outputs finished high-level code in the system target language; PL/M, Pascal, C, or Coral, the British Ministry of Defence's real-time language. **–K.S.**

PHOTOVOLTAICS

NEW DESIGNS FOR SPACE

Redondo Beach, Calif.—To serve new generations of spacecraft—growing ever larger to pack more sophisticated payloads—that workhorse power source, the flat silicon solar cell, may not be able to measure up. Some space platforms now on the drawing board will be so power-hungry that 100 kW will be required, which would mean solar panels of nearly unmanageable size.

Miniaturization obviously is one answer, and that is an approach being pursued by TRW Inc.'s Space and Technology Group here. To pack more power generation into a smaller package, researchers have combined two elements that never quite made the grade in earthbound solar-cell work: concentrating sunlight on a cell to boost output, and employing gallium arsenide, instead of silicon, as a photovoltaic material.

The TRW solar-cell development, funded by the National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala., uses an almost 2-in.-diameter Cassegrainian telescope configuration as the concentrating element. At the focal point of the concentrator lies a 0.25-cm^2 GaAs cell. Together they convert sunlight into electricity at the rate of 0.43 W/cell. By comparison, present flat solar-cell designs need about 30 cm^2 of silicon to produce the same power.

The big advantage of the TRW concept is that "the miniaturized approach allows us to use a more efficient cell material," notes Robert E. Patterson, manager of the power-source department who directs solar-array research. Though the high cost of GaAs has largely ruled out its use in terrestrial power, the tiny amounts employed in the concentrator negate this factor, he says. For the same power output, he estimates that the required amount of GaAs is "one to two orders of magnitude less than conventional planar solar arrays."

Cooling. But some challenging engineering questions are posed by the concentrator, mainly centering around the problem of cooling it—a problem not yet satisfactorily solved in an economical manner for earth systems. While supercold space temperatures make the task easier, TRW engineers had to place the GaAs cell on a passive cooling material, which acts as a "radiator" or heat sink. This radiator is currently 10-mil-thick electroformed copper integrated with the reflector itself. Even so, the TRW array would run 15° to

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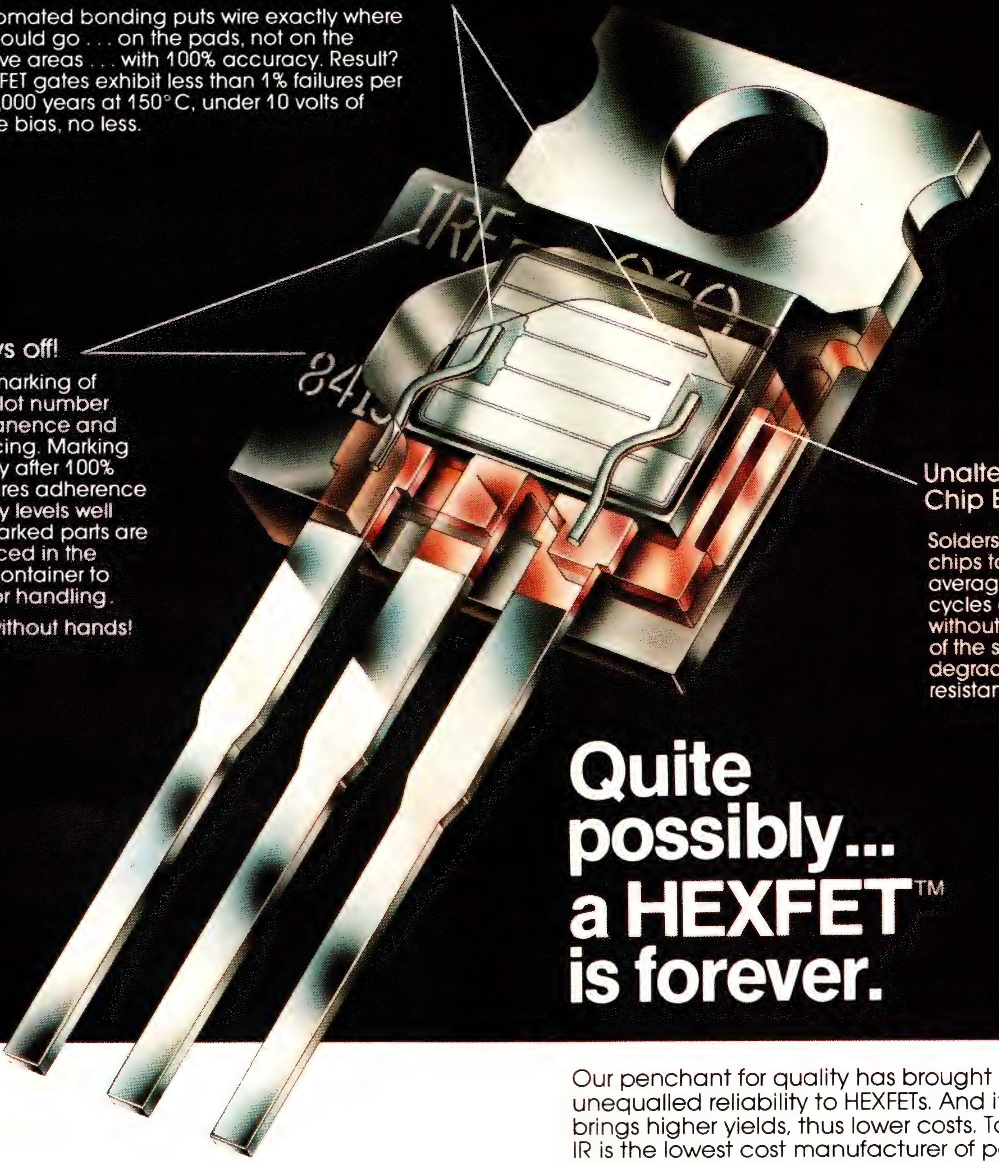

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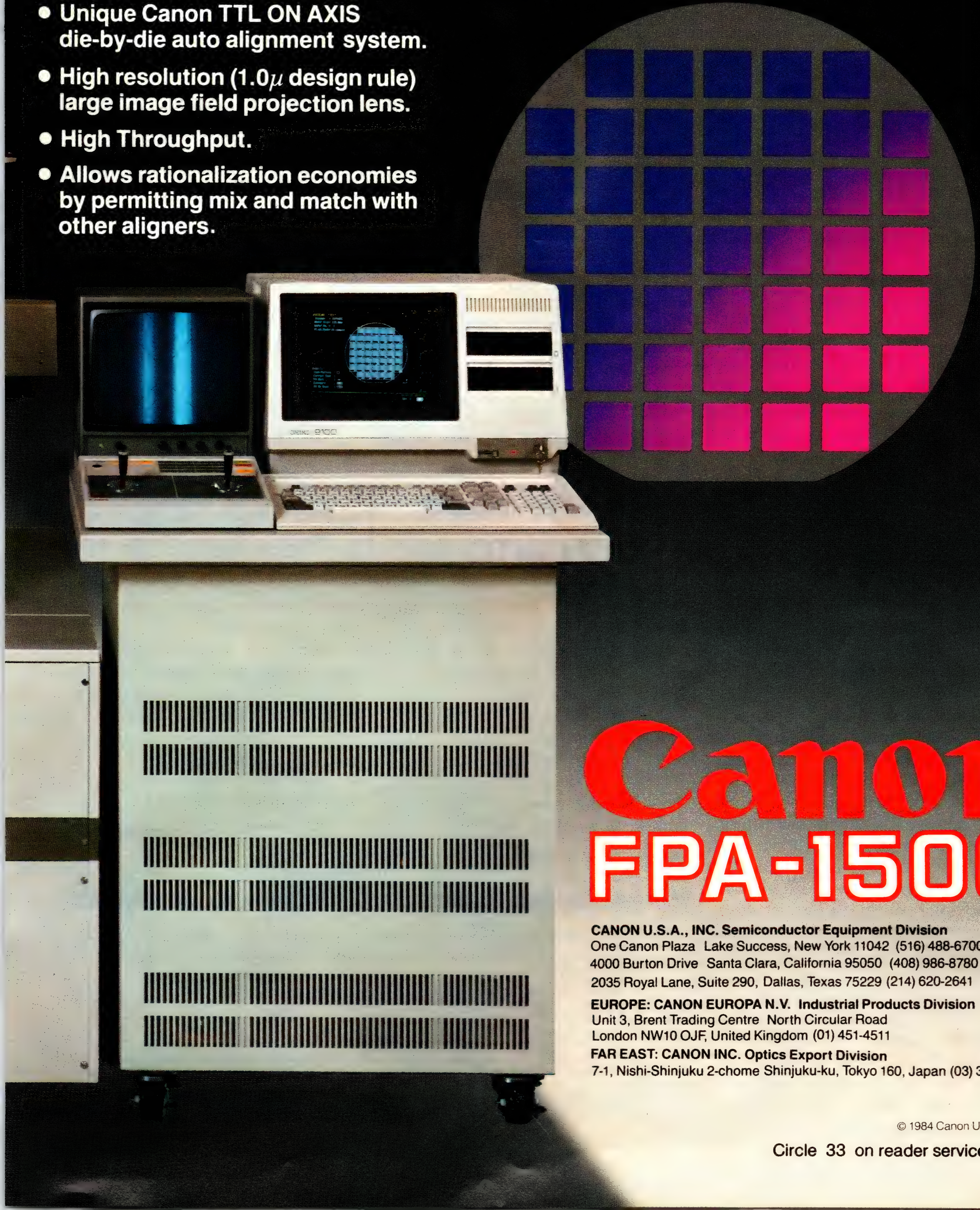

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Electrifying. TRW's new design for a solar cell collector, which uses gallium arsenide instead of silicon, may cut the size of present-day solar arrays used to power spacecraft in orbit.

20°C warmer than a silicon planar array, which is acceptable.

In the TRW concentrator, sunlight reflects up from a primary parabolic mirror with a concave surface to a secondary hyperbolic mirror's convex surface. From there, the concentrated rays are focused back down onto the center of the primary mirror and into the solar cell.

Small start. TRW is now working on a panel with a limited number of concentrators to prove this level of operation, and over the next year it will build for NASA a full-scale panel with about 1,200 concentrators. Close up, the Cassegrainian units will be visible, each resembling a flashlight reflector, but at a distance they look similar to a conventional solar panel, explains Patterson.

The TRW engineer says the miniaturized design of the concentrator-type solar array makes possible important size reductions that, in turn, help improve the flight characteristics of the spacecraft itself. He estimates the solar-cell area needed at the geosynchronous altitude of 22,300 miles could be cut by 40%. At lower altitudes, the saving is even bigger—a 60% to 70% reduction, he predicts.

One operating factor is more difficult with the concentrator array than with flat panels, Patterson notes: pointing them precisely enough toward the sun to focus the light beams. But existing technology for positioning and aiming satellites performs within far more critical limits than required for the arrays. "I am optimistic we can adapt this pointing technology," he says. –**Larry Waller**

ARTIFICIAL INTELLIGENCE

SPERRY MAPS PUSH INTO AI

New York—Paving the way by signing agreements with Texas Instruments Inc. and Intellicorp, Sperry Corp. is putting together a massive $20 million effort to claim the No. 1 spot in the artificial intelligence and expert-systems business.

As a focal point for the enterprise, the company says it will open a multimillion-dollar Knowledge Systems Center in Minneapolis, across the Mississippi from its defense products group and semiconductor operations in St. Paul, Minn. The center will handle both commercial and defense markets.

Speaking in New York at the company's advanced computer technology symposium earlier this month, the director of the center, Larry L. Walker, said he predicts a 68% growth rate over the next five years, to $4 billion (see chart). The potential of the AI market is attracting many companies, which in turn will feed the market, he reasoned.

Explorations. Sperry intends to initiate a variety of AI-product programs with TI, the Dallas semiconductor giant, which last month introduced Explorer, a single-user Lisp-based personal computer [*ElectronicsWeek,* Oct. 8, 1984, p. 19]. TI has been trying to woo academic markets with discounted prices and donations of Explorers to the Massachusetts Institute of Technology. Now the firm hopes its arrangement with Sperry will accelerate acceptance of Explorers in emerging government, defense, and aerospace markets.

"Sperry has a strong sales position in these market segments, which are the leading early adopters of AI technology," explains Daryl Robertson, marketing manager for Explorer at TI's Data Systems Group, Austin, Texas. The two companies also intend to investigate joint bids, cooperative software development, and training programs.

Sperry will distribute the Knowledge Engineering System from Intellicorp, which makes AI software in Menlo Park, Calif., and use it to develop expert-system-based products, which the firm calls knowledgeware. It is targeting both businesses and governments in this effort.

Sperry also plans to embed expert

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Segment	1983	1987	1990	Growth rate (%)
Expert systems	16	800	1,243	86
Natural-language software	18	190	1,090	79
Computer-aided instruction	7	30	100	46
Visual recognition	30	230	860	60
Voice recognition	10	50	230	56
AI hardware	25	200	500	54
Total AI market	106	1,500	4,023	68

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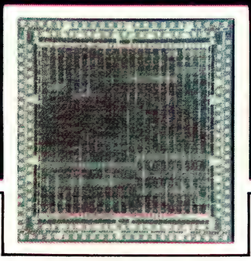

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systems in a variety of defense-related functions such as navigation, sonar, and command, control, communications, and intelligence, or C^{3}I, operations. –**Michael Rand**

SEMICONDUCTORS

GAAS GIVEN THE GAS

Boston—More than ever before, the talk about gallium arsenide revolves around manufacturing problems instead of the laboratory problems that occupied most discussion until recently. But while there is much talk about making products, production is still limited. Sven Roosild, assistant director for electronic services in the Defense Advanced Research Projects Agency, Defense Sciences Office, recently surveyed a number of companies to discover why there isn't more production.

Among the primary problems in manufacturing GaAs parts, materials and process control were cited most often by the 18 companies responding to the survey. The lack of high-speed packages and circuit models was cited by fewer companies, and problems regarding the lack of test equipment and dedicated customers were checked by fewer still.

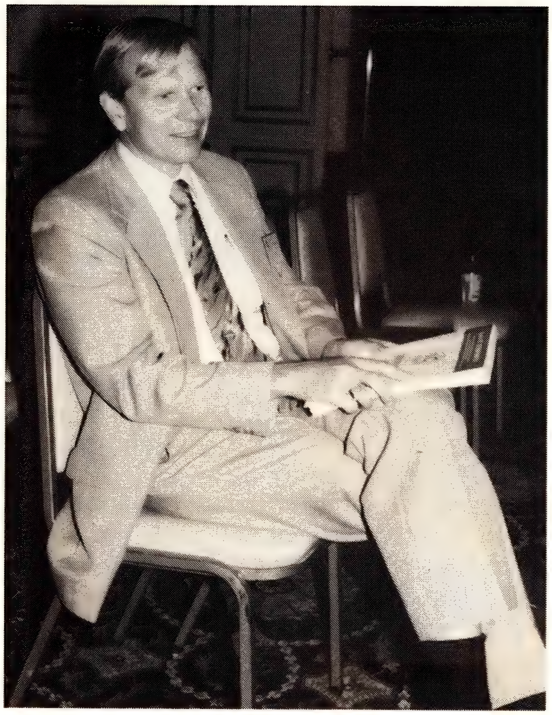
Respondents indicated that materials now available were adequate for depletion-mode metal-semiconductor FETs, but they questioned the adequacy of the material for enhancement/depletion implementation or large-scale integrated circuits.

No consensus. Reporting the survey results at an Institute of Electrical and Electronics Engineers GaAs symposium in Boston late last month, Roosild said there was no consensus that high dislocation counts in the material were a problem, although most did agree that lack of reproducibility was a handicap. Most companies also expected improvements in materials within three years that would allow movement toward some form of enhancement/depletion-mode logic and integration levels in excess of 2,000 gates. At least one person anticipated improvement even sooner.

"You will see dislocation-free GaAs within the next two years," says Robert E. Lee, who is section head in IC technology, GaAs devices, for Hughes Research Laboratories in Malibu, Calif. After that is available, Lee says, the next step would be the movement toward enhancement-mode MES FETs.

Darpa's view is that adequate materials are available now for digital very large-scale integrated circuits and that the low yields obtained for LSI GaAs circuits are caused by random processing defects. Roosild says an objective of the survey was to determine why there was no manufacturing capability at even pilot-line level to meet the Department of Defense's need for digital GaAs circuits. He concluded that the reasons lay more in market factors than in technical problems.

Addressing requirements. In order to meet its own needs for GaAs parts in the near future, the government has contracted with Rockwell International Corp., Pittsburgh, and Honeywell Inc., Minneapolis, for a pilot line, says Roosild. The goal for the project is the production of 100 wafers per week within three years for 16-K random-access memories and 6,000-gate arrays.



Company survey. After taking a survey of U.S. suppliers, Darpa's Sven Roosild concluded that materials were a major obstacle to greater GaAs circuit production.

"From our point of view, the market forces weren't going to give us the parts we need," says Roosild. "What we want to do is build an AOSP [advanced on-board signal processor] brass board out of the pilot project."

At the GaAs symposium here, Roosild says papers by the Japanese were particularly impressive. "In the last two to three years, the Japanese have really done some very fine work. We clearly are no longer leading the state of the art in digital. They seem to do less in analog—I'm not quite sure I know why."

According to Roosild, the conference provided important data on dislocations, something unavailable until recently, as well as data that confirmed GaAs's promise of increased speed and lower power. The evidence now is that "if you compare speed at the same power level, you get at least a factor of two. If you compare power at the same speed, you get at least a factor of 10."

The government, however, is primarily interested in GaAs for a third reason: its radiation hardness. This puts the government in a different position from industry, which is moving to the material primarily because of its speed.

Bruce Hoffman, manager of product marketing for Harris Microwave Semiconductor in Milpitas, Calif., says the Darpa survey underestimated the GaAs industry. "We feel the industry is more mature than was indicated in the survey." He adds, however, that "in getting to LSI levels or higher, materials will have to improve."

Bryant Welch, vice-president of manufacturing for GigaBit Logic Inc., in Newbury Park, Calif., assigns different priorities to manufacturing problems. "Of all the things, I would 'X' the hardest [problems with] test equipment. The reason is this: There is no commercial hardware capable of doing gigahertz testing."

Welch thinks packaging is also a problem in

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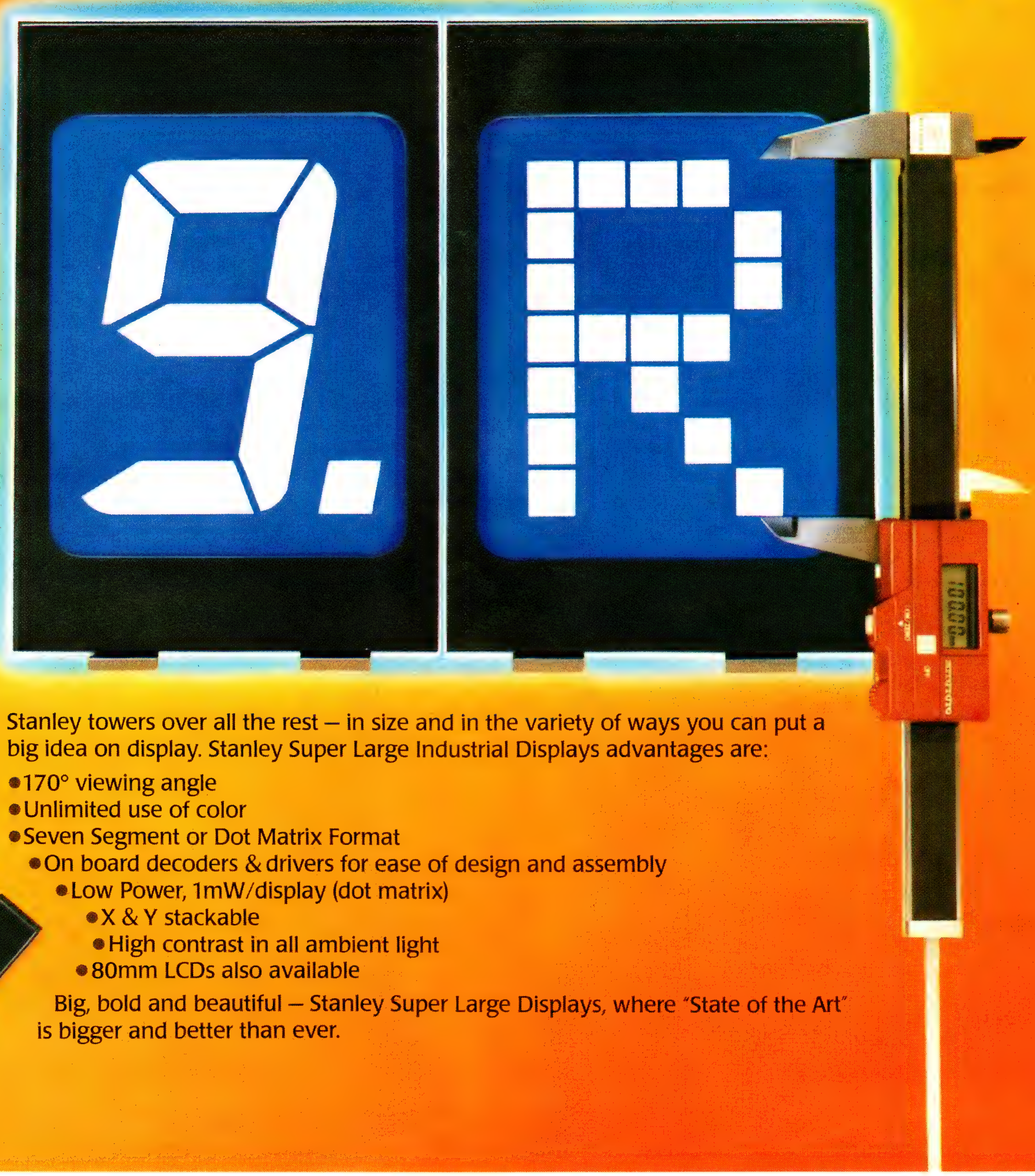

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manufacturing GaAs devices, but that materials is not. "We thought it was going to be a problem, but we're getting adequate material for depletion-mode technology."

Approximately 775 people attended the symposium, for which 100 papers were submitted, according to chairman James Vorhaus, a research scientist at Raytheon Co. in Lexington, Mass. "From 1979 to 1982, attendance grew at a modest 10%. Last year attendance was up 40% and this year it's up 40% also. There were a lot of financial analysts in attendance, and a lot of companies I didn't recognize as having anything to do with GaAs." However, he says there was a decrease in the number of Japanese. **–Craig D. Rose**

BUSINESS ABROAD

COMPONENT SALES PEAK IN EUROPE

Munich—The international market for components, particularly integrated circuits, is going through a period of healthy growth. But while IC shipments have crested during the third quarter of this year in the U.S. and Japanese consumption has already begun to decline, the peak in much of Western Europe is still to come.

That is one major finding of a recent study by the European Semiconductor Industry Service, the London-based service of Dataquest Inc., the San Jose, Calif., market research firm. It is also the message that visitors to this week's Electronica components show will receive. Here at the Bavarian capital's sprawling fairgrounds, an estimated 90,000 components experts will gather to eye the wares of some 2,180 companies from around the world.

The general economic upswing in the U.S. last year, the above-average growth in the Japanese gross national product, and the recovery in western Europe have combined to "impact electronic components with full force," according to Fritz A. Lohmann, director at Philips GmbH, the German subsidiary of the Dutch electronic giant, and head of its components-producing affiliate Valvo in Hamburg.

Taking a look ahead, the Philips executive sees worldwide electronics production rising at double-digit annual rates, from $217 billion in 1983 to more than $357 billion in 1988. Pacing the growth, Lohmann says, are "primarily integrated circuits with their innovation potential." It is little wonder, then, that he predicts a worldwide annual rise for IC sales—currently running at about $18 billion—of at least 20% over the period from 1983 to 1988, with MOS products increasing their share at the expense of bipolar digital circuits.

Given this scenario, it is not surprising that the mood at Electronica this year will be one of optimism, in contrast to the 1982 show, when there was much apprehension over the short-term prospects for components [*Electronics*, Nov. 3, 1982, p. 79]. "The order books are full, the semiconductor industry is making money as never before, and it is investing also as never before," exults Gernot Oswald, sales director for semiconductors at the Components Group of Siemens AG in Munich.

But how long will that last? Warns Oswald, "other indications are that incoming orders are stagnating at present, delivery times are getting shorter, and the book-to-bill ratio is approaching one."

West Germany

A country-by-country survey shows that West Germany is still the biggest components market, with consumption approaching the $3.5 billion level this year. That spells a 15% rise over 1983.

Semiconductor sales, accounting for about one third of the components market, could go to $1.16 billion this year, according to Frankfurt's Central Association for the Electrotechnical Industry. It forecasts a 15% semiconductor growth for 1985. IC sales, at $775 million this year, should grow more than the average for semiconductors.

One peculiarly German phenomenon that is undergoing a change, Oswald notes, is the attitude that large segments of the population, particularly labor unions, display towards

Strolling. A crowd of some 90,000 components vendors and their customers are expected to mill around the aisles of this year's Electronica Show in a reasonably optimistic mood.

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SPRAGUE
THE MARK OF RELIABILITY

Circle 39 on reader service card

new technologies. If, in the past, microelectronics and automation were widely held to be job killers, this view is giving way to an unemotional and sober assessment of new technologies. A strong involvement in microelectronics is increasingly regarded as a prerequisite for a highly industrialized and export-oriented country. **–John Gosch**

United Kingdom

It could not last, and 1985 will be the year when it did not. For the past three years, Britain's booming electronics industry has been devouring ICs in ever-greater quantities, with growth rates of between 40% and 50% annually. This has made the UK, arguably, Europe's largest IC market.

Then, in the first quarter of 1984, the book-to-bill ratio began to slide. From a high of 1.7 to 1.8, it has dived to a level of just over 1, according to one major supplier. Of course, the remarkably high UK book-to-bill ratios reflect, in part, the inevitable double ordering that accompanies a supply shortage. But, says market-watcher Dataquest, 1984 saw a lot of new capacity come on stream, and supply has now caught up with demand.

Right now it is anybody's guess what IC sales will be next year, believes Mike Alderson, UK marketing manager for Motorola Semiconductors Ltd. When pressed as to his guess, he settles for something between 15% and 25%. Another semiconductor major settles for a 5%-to-15% figure in 1985.

The bellwether sector that most are watching is Britain's booming personal-computer business. Unlike those in the U.S., sales of home computers have stood up pretty well in the UK, but the make-or-break Christmas sales rush is fast approaching, and this year it could signal a shake-out.

"We are watching our credit control in that sector like a hawk," observes one supplier.

David Benda, Mullard Ltd.'s market watcher, believes that the industry, after three years of exceptional growth, will be down to the base IC growth rate of approximately 25%. For the fourth quarter of 1985, the year-on-year growth will be down to 5%. In part, this downturn will reflect a softening in prices. Benda says that prices for 64-K random-access memories have fallen by as much as 25% to 35%. **–Kevin Smith**

France

"As usual, the French components market took off later than the American, British, or German markets, and also as usual, it is beginning to turn down at just about the same time," laments Philippe Dauvin, director of economic research at Thomson Semiconducteurs, the semiconductor division of Thomson-CSF in Paris.

But even though average French book-to-bill ratios in components have fallen from a whopping 1.5 in June to their current level of from 1.05 to 1.10, Dauvin expects to see the country's semiconductor market expand by as much as 35% this year to a total consumption of some $620 million. In 1985, a figure just short of a respectable 20% should be added to that total.

Underpinning that growth, says Dauvin, is strong demand in the data processing sector, particularly from IBM Corp., whose European operations are based in Paris.

The other significant growth area is the automotive sector, where French manufacturers have begun introducing up-market models that are stuffed with electronic gadgetry. Lagging behind are the telecommunications, industrial, and military sectors, although Dauvin expects to see the industrial sector take off when sales of automation equipment get into high gear. **–Robert T. Gallagher**

Italy

At Agrate, the suburban Milan home of SGS Componenti Elettronici SpA, Italy's largest components manufacturer by far, director of market research Enrico Villa describes the situation in his country as "still quite good, largely due to the expanding marketing plans of IBM, Olivetti, and Honeywell."

Villa expects Italy's semiconductor market this year to be worth about $400 million, up roughly 40% in constant lire. Villa looks for some price decline in 1985, but feels that the market will still grow reasonably well—probably around 25%—because of the telecommunications and data-processing sectors. **–R.T.G.**

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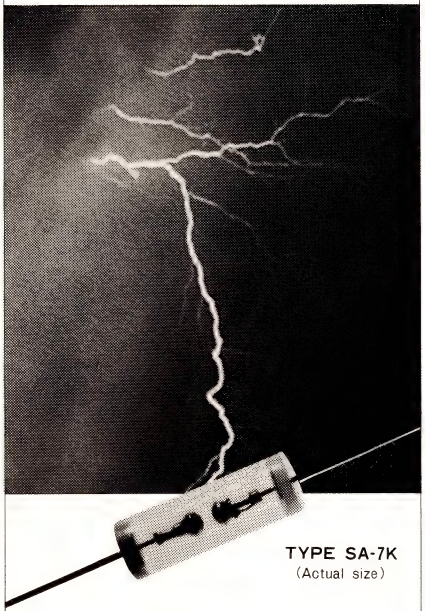

TYPE SA-7K
(Actual size)

● *TYPE*

Type	Breakdown Voltage (V) D	Insulation Resistance (Ω)	Maximum Surge Current (8×20us) KA	Life Times at 500A
SA-80SS	80±10%	10^{10} min	1.0	1000
SA-200SS	200±10%	10^{10} min	1.0	1000
SA-80	80±10%	10^{10} min	1.5	3000
SA-140	140±10%	10^{10} min	1.5	3000
SA-200	200±10%	10^{10} min	1.5	3000
SA-250	250±10%	10^{10} min	1.5	3000
SA-300	300±10%	10^{10} min	1.5	3000
SA-7K	7000±1000V	10^{10} min	—	5000
SA-10K	10000±1000V	10^{10} min	—	5000
SA-180D(3)	180±10%	10^{10} min	2.5	10000

SA-180D(3) is a three electrode discharge tube.
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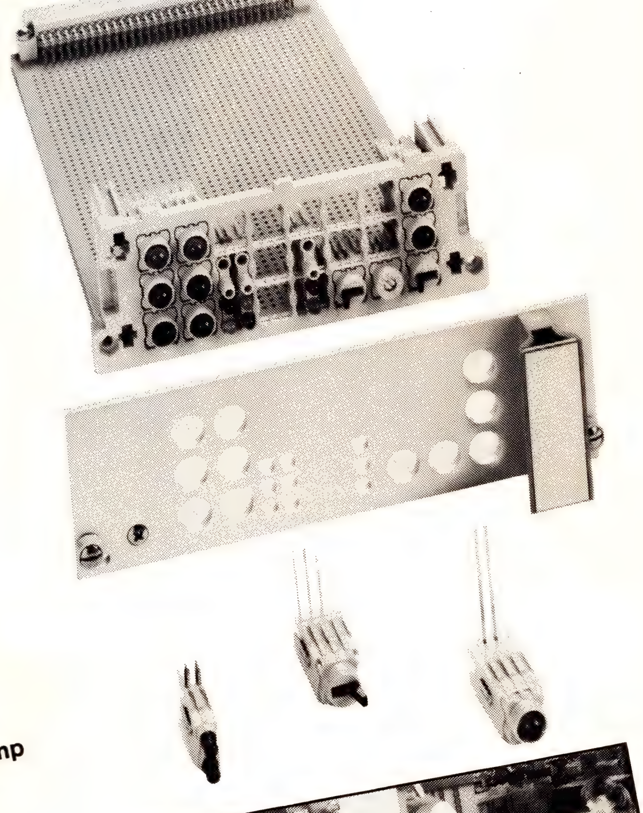

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V_{RRM} = 200, 300 and 400 V
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t_{rr}: from 25 to 50 ns max.
V_F/I_O = 1.4 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
1 A	F 126	BYT 01	
3A	DO 27	BYT 03	
8A	DO 220	BYT 08 P	BYT 08 PI*
12A	DO 4	BYT 12	
16A (2 x 8)	TO 220	BYT 16 P	
30A	DO 5 DOP 3	BYT 30 BYT 30 P	BYT 30 PI*
60A	DO 5 DOP 3	BYT 60 BYT 60 P	
60A (2 x 30)	ISOTOP		BYT 230 PI*

**Insulating voltage: 2500 VRMS*

V_{RRM} = 600, 800 V
ultra-fast free wheel diode
t_{rr} max. ≤ 60 ns
V_F/I_O = 1.7 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
12A	DO 4 DO 220	BYT 12 BYT 12 P	**BYT 12 PI***
30A	DO 5 DOP 3	**BYT 30** BYT 30 P	**BYT 30 PI***
60A (2 x 30)	ISOTOP		**BYT 230 PI***

**Insulating voltage: 2500 VRMS*

V_{RRM} = 1000 V
ultra-fast free wheel diode
t_{rr} max. ≤ 70 ns
V_F/I_O = 1.8 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
12A	DO 4 DO 220	**BYT 12** **BYT 12 P**	**BYT 12 PI***
30A	DO 5 DOP 3	**BYT 30** **BYT 30 P**	**BYT 30 PI***
60A (2 x 30)	ISOTOP		**BYT 230 PI***

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V_{RRM} = 50, 100, 150, 200 V
t_{rr}: from 25 to 50 ns max.
V_F/I_O = 0.85 V

$I_{F(AV)}$	CASE TYPE	NON INSULATED CASE	INSULATED CASE
1 A	F 126	BYW 100	
3A	DO 27	BYW 98	
7A	DO 220	BYW 80	
15A	DO 4 DO 220	BYW 81 **BYW 81 P**	**BYW 81 PI***
20A (2 x 10)	TO 220	BYW 51	
25A	DO 4 DOP 3	BYW 77 **BYW 77 P**	**BYW 77 PI***
30A (2 x 15)	TOP 3	**BYW 99 P**	
35A	DO 5	BYW 92	
50A	DO 5	BYW 78	
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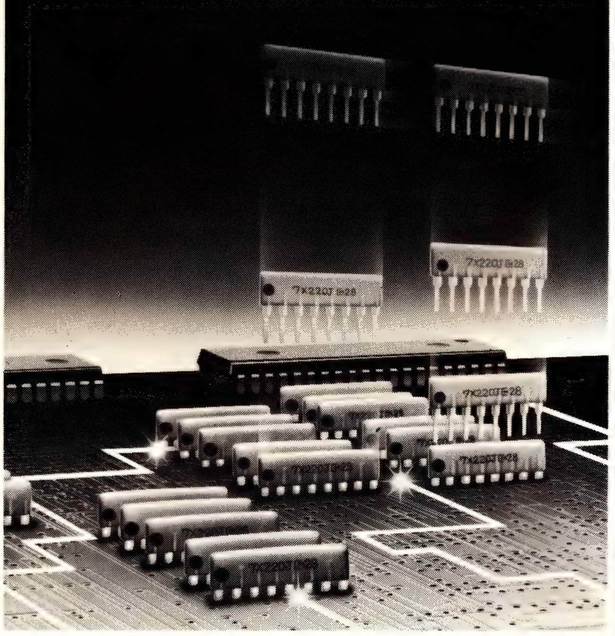

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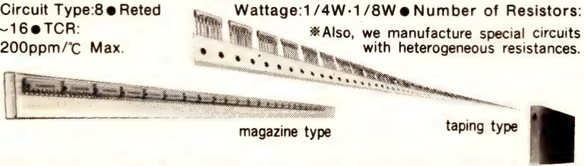

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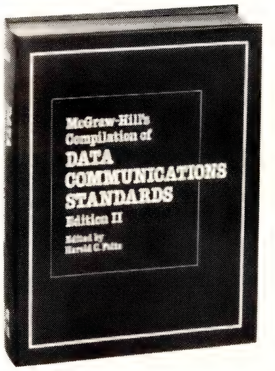

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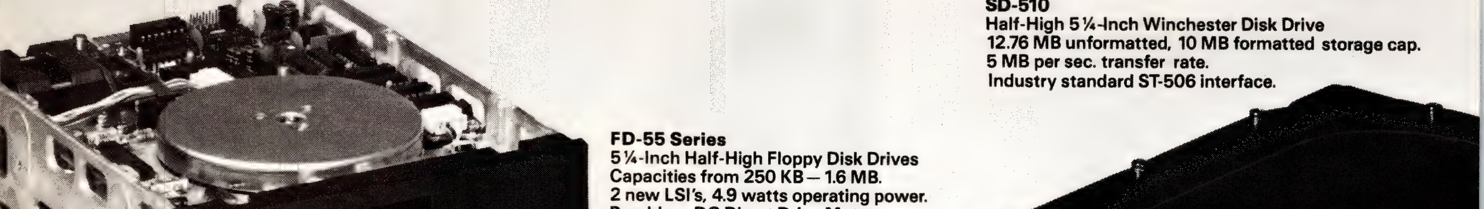

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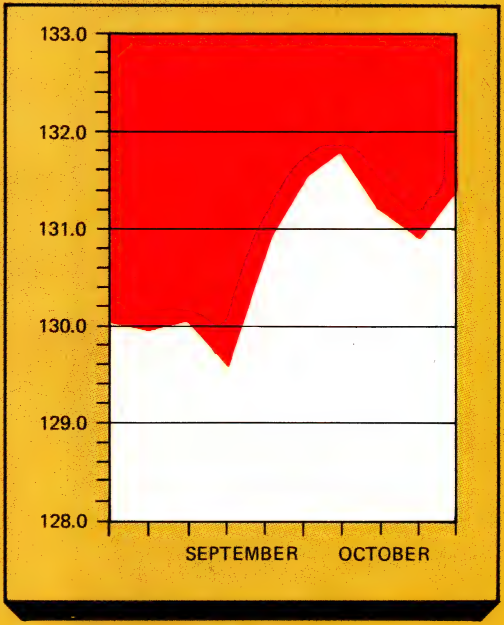
ElectronicsWeek Index



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LAST WEEK = 131.0
YEAR AGO = 98.9
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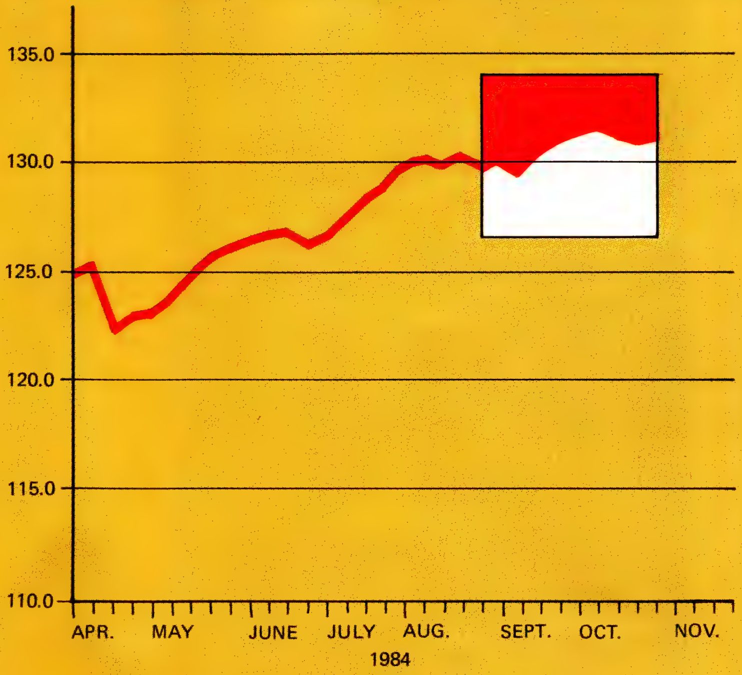


The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

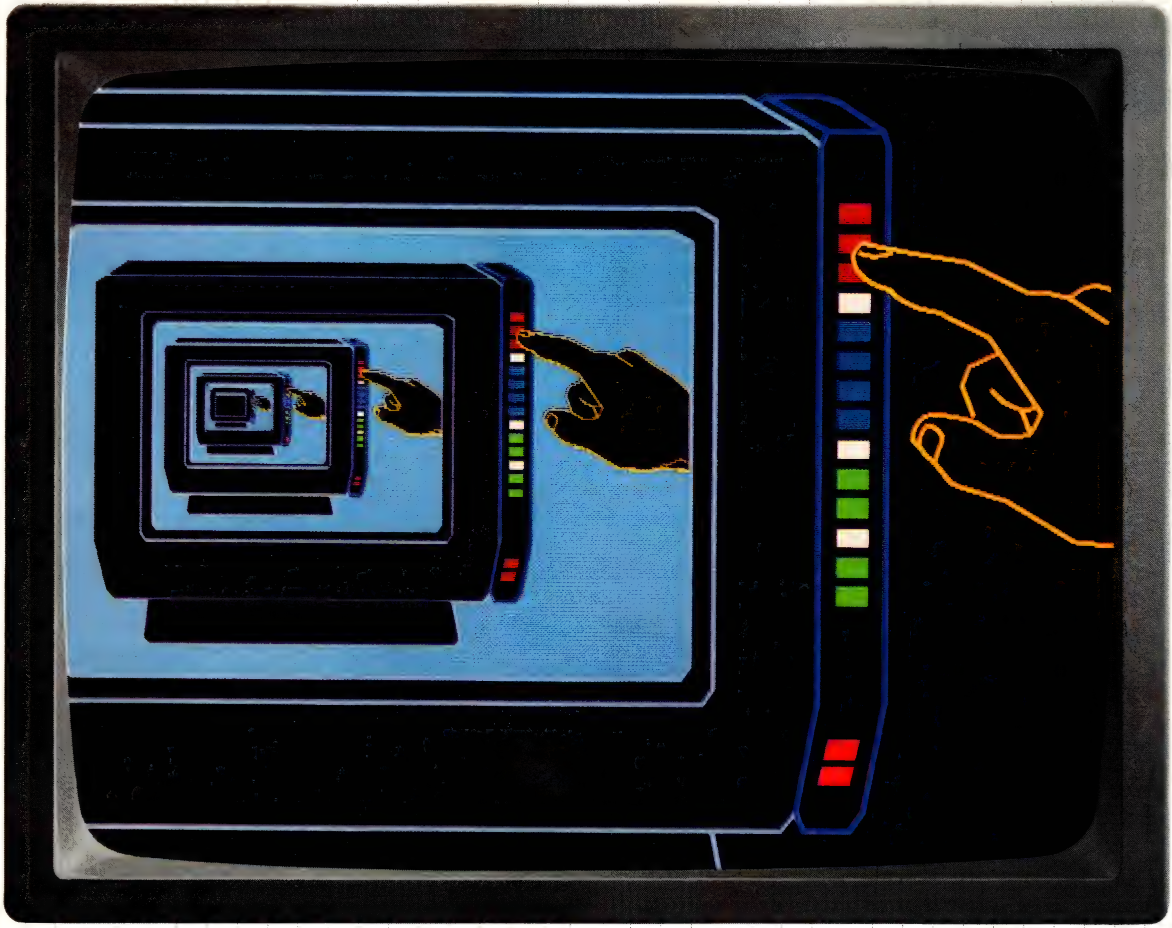
U.S. ELECTRONICS INDUSTRY SHIPMENTS

Shipments ($ billions)	August 1984	July 1984	August 1983
Communications equipment	4.670	4.360	3.665
Radio and TV receiving equipment	0.948	0.930	0.690
Electronic and electrical instruments	4.701	4.883	4.145
Components	3.935	3.814	2.993

U.S. ELECTRONICS ECONOMIC INDICATORS

	September 1984	August 1984	September 1983
Index of leading economic indicators	164.5 (Aug. 1984)	163.7 (July 1984)	158.9 (Aug. 1983)
Budgeted outlays of the federal government ($ billions)	51.2	88.7	61.6
Budgeted outlays of the Department of Defense ($ billions)	18.9	20.1	18.1
Operating rate of all industries (% capacity)	80.2	81.0	77.0
Industrial-production index	165.1	166.1	153.8
Total housing starts (annual rate in thousands)	1,676	1,539	1,754

Despite falling economic indicators, manufacturers' shipments of electronics equipment were surprisingly healthy. Sparked by a large rise in shipments of communications products, total shipments of electronics equipment rose 1.8%. This helped push the *ElectronicsWeek* Index ahead by half a percentage point in the latest week. A continued slide in interest rates could weaken the dollar and help sustain good economic activity. This would enable electronics firms to finish off 1984 with a strong fourth quarter.



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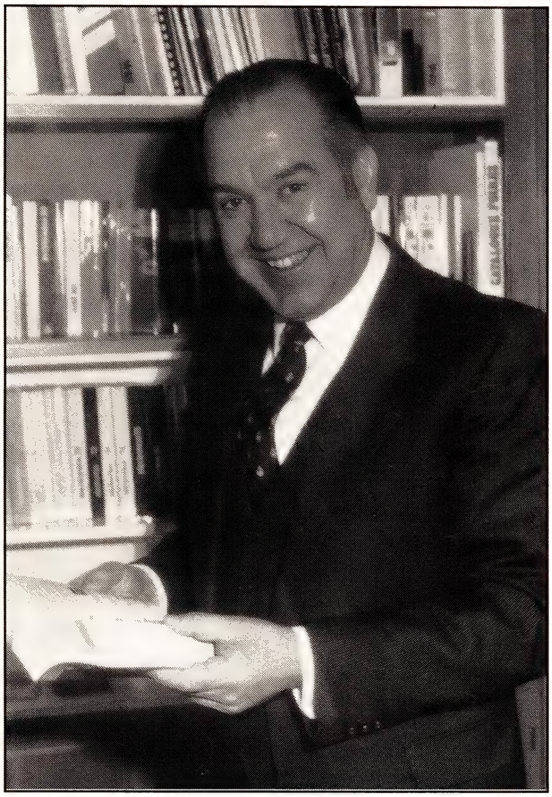
'FAIR PIONEER' VOM HÖVEL SETS PACE FOR EUROPE'S SHOWS



Spark plug. Gerd vom Hövel, managing director of the Munich Fair Co., has applied his successful Electronica show strategy to spark other electronics exhibits.

Munich

He is not its founder, but as managing director of the Munich Fair Co. Gerd vom Hövel is clearly the man who during the past 10 years has made Electronica what it is today: the biggest electronics show in Europe—if not the world—devoted entirely to components and component assemblies.

This year's biannual Electronica—which runs Nov. 13 to 17—will attract nearly 2,200 exhibitors to the sprawling fairgrounds of this Bavarian metropolis. An expected 90,000 visitors will scrutinize the wares in the 19 exhibition halls sprawled over 10 acres of display area on the Munich fairgrounds.

Vom Hövel sees the Munich show not so much in terms of quantity but of quality. "An exhibition should fulfill a number of requirements if it wants to be a success," he says. It must constitute a platform for expert information exchange. It should be a forum where managers can get input for product marketing strategies.

It must be "an ordering instrument, one that opens doors to future business. It should be a forum for export contacts and, finally, a showcase for innovative products and a center for a visitor's further education."

Electronica is an excellent example of vom Hövel's philosophy. Under his management, the show has grown into what one observer calls a "practice-oriented university," a forum for the further training of the electronics engineer, salesman, administrator, and marketing specialist. The Microelectronics Congress, concurrently held on the fairgrounds, allows information exchange not only between theoreticians, but also between theoreticians and the practitioners in the adjacent exhibition halls.

Also, Electronica's exclusive, components-only nature guarantees that it is a place for the specialist, not the generalist. Also keeping the merely curious out are stiff admission fees: this year, a day's ticket costs $12.

Keeping up. What's more, the show strives to keep visitors abreast of special aspects in the field. In 1982, it was macroelectronics—large components such as power devices; this year, the emphasis in papers, discussions, and on the floor will be on component quality.

Vom Hövel, 54, has a master's degree in industrial management from the University of Munich. He joined Raab Karcher GmbH, Germany's largest fuel-supply company, where, as marketing and sales manager, he devised concepts for that firm's representation at fairs. He has been with the Munich Fair Co. for the past 20 years, becoming managing director 10 years ago.

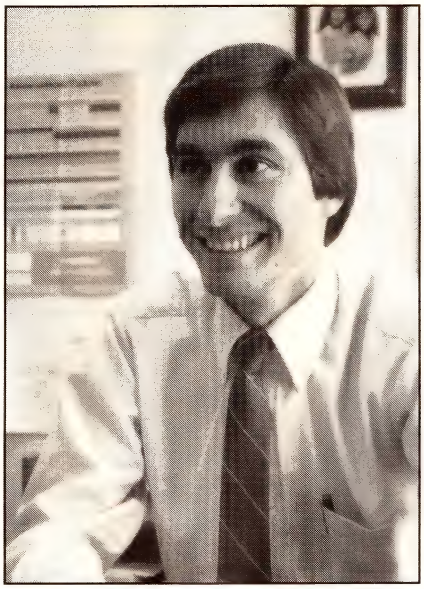
That vom Hövel has earned the unofficial title of "fair pioneer" in Germany is due not only to Electronica's success. He sees that show mainly as a part—though an essential one—of a whole cycle of fairs he has created and made into major events in the electronics industry. These are the Systems show, for data processing and communications equipment; Analytica, for biotechnology; Productronica, for production equipment; and Laser, for optoelectronic gear.

No wonder his strategy is emulated by other show organizers in Europe, or that his advice is sought abroad. The German government has even awarded him the Federal Service Cross for his accomplishments in promoting international exhibitions and congresses. **–John Gosch**

Cooper sees broadband stirring

Mountain View, Calif.

Having been involved in the broadband local-area-network arena for more than 10 years, Edward Cooper, of Sytek Inc., here, is "satisfied to see it coming to fruit now." As chairman of the Institute of Electrical and Electronics Engineers' 802.7 standards committee, he is aware of the many vendor and user requirements for broadband communications. His task is to shepherd the production of a draft of local-net procedures and specifications, which is expected to be completed in about six months for presentation to



Vested. While he chairs the IEEE 802.7 standards group, Edward Cooper also keeps the broadband industry's interests at heart.

the rest of the 802 committee.

From the start of his engineering career at General Electric Corp. in 1971, Cooper's attention was attracted to broadband LANs based on cable-TV coaxial cable as a means of tying together the various forms of data, voice, and visual communications. He helped develop GE's broadband data-communications standards and worked on similar projects for General Motors Corp. and American Motors Corp.

CATV a comer. Cooper believes that the CATV medium "has the strongest possibility of being standardized than any other medium. Its head start in standards gives it the potential to become a true standard medium."

When he joined Sytek Inc. in 1981, Cooper felt the implementation of broadband networks was still in its infancy. Misconceptions about it were being circulated by purveyors of other types of nets, he felt, and by inexperienced workers within the broadband industry itself.

"I set out to set the record straight," he says. Thus his first role with the company was as an educator and marketer—sort of a broadband guru carrying the message that "broadband was a sleeping giant."

IBM Corp.'s recently announced contract with Sytek for adapter cards and a license to Sytek's LocalNet PC protocols for use in IBM's PC Network [*ElectronicsWeek,* Aug. 20, 1984, p. 17] indicates that the giant is at last awakening. From his perspective as Sytek's manager of network integration, Cooper visualizes the firm becoming "a very large corporation" and moving from its reputation as a networking company to that of a full-systems company.

Cooper admits to having a vested interest in the outcome of the competition between broadband and other media but insists he's always approached his work "from an industry mode, not from a vendor's viewpoint." Thus, he says, "everyone knows my intentions are for the benefit of the industry." This attitude should place him in a position of respect as the 802.7 standards are hammered out. **–Eve Bennett**

Vermilion connects nonprofit groups

Cupertino, Calif.

Nonprofit community organizations have just as much use for computers as their for-profit cousins, but they can seldom justify the time and expense of buying and learning to use them. Over the past two years, Apple Computer Inc. has given computer equipment and training to some 500 nonprofit groups under a community affairs program that is probably without parallel in the industry.

The program was the brainchild of Mark Vermilion, who convinced Apple brass that it was worthwhile and implemented it so well that this month he was was named manager of corporate grants. The community affairs program has been responsible for grants of equipment valued at over $2 million in the past two years, and Vermilion now supervises a staff of 13 at Apple. Yet when he came up with the idea, he didn't even work there.

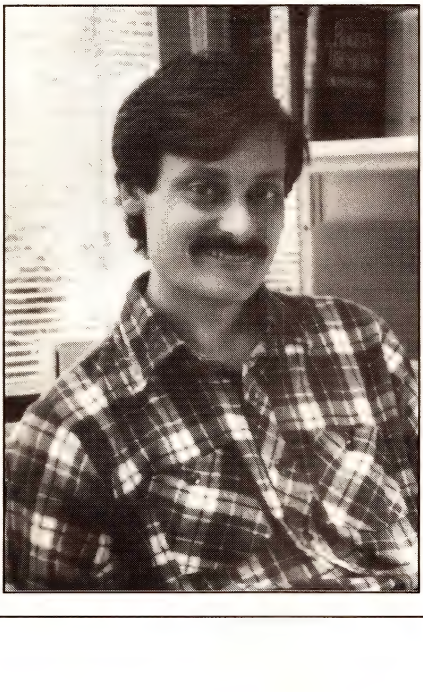
Apple was receptive. Vermilion, 34, was a consultant for Humanitas International, the human rights organization founded by folksinger Joan Baez, when he first approached Apple and asked for a single computer. Apple had no formal gifts program but came through with an Apple II+. Vermilion, who had had some difficulty justifying even a single microcomputer to Humanitas, then realized that an information-sharing network of personal computers was an even more powerful tool.

"I had no idea whether or not it would work," he says. "But I asked for a little bit of Steve Jobs's time and persuaded him that Apple should have a program to support community-based groups, that the focus should be on information sharing, and that I should be the person to run the program."

Jobs, Apple's founder and board chairman, liked the idea and hired Vermilion. Besides running the community affairs program, Vermilion supervises Apple's education affairs program, under which it provides computer equipment to schools.

The community affairs program is unique in that it donates its equipment in clusters—to three to five groups at a time—that are already in contact with one another. Apple gives grantees 3½ days of training at its headquarters here, and provides the modems and software for electronic communication and access to outside data bases. Tymshare Inc., located nearby, donates 100 hours use of its OnTyme electronic mail system.

Vermilion's goal is "to break new ground in the use of technology. I want to take the program as far as I can in applying the idea of networking to educational and community organizations." **–Clifford Barney**



Robin Hood. Mark Vermilion convinced Apple brass that it was worthwhile to donate computers to nonprofit organizations.

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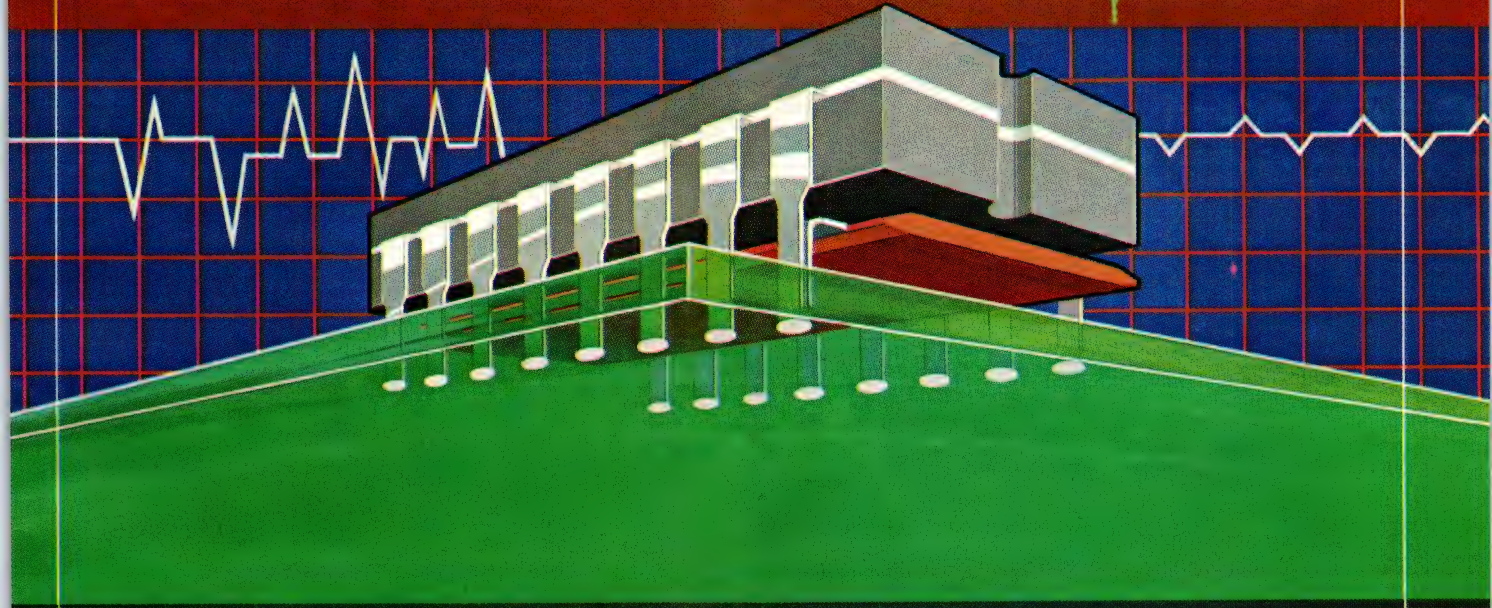

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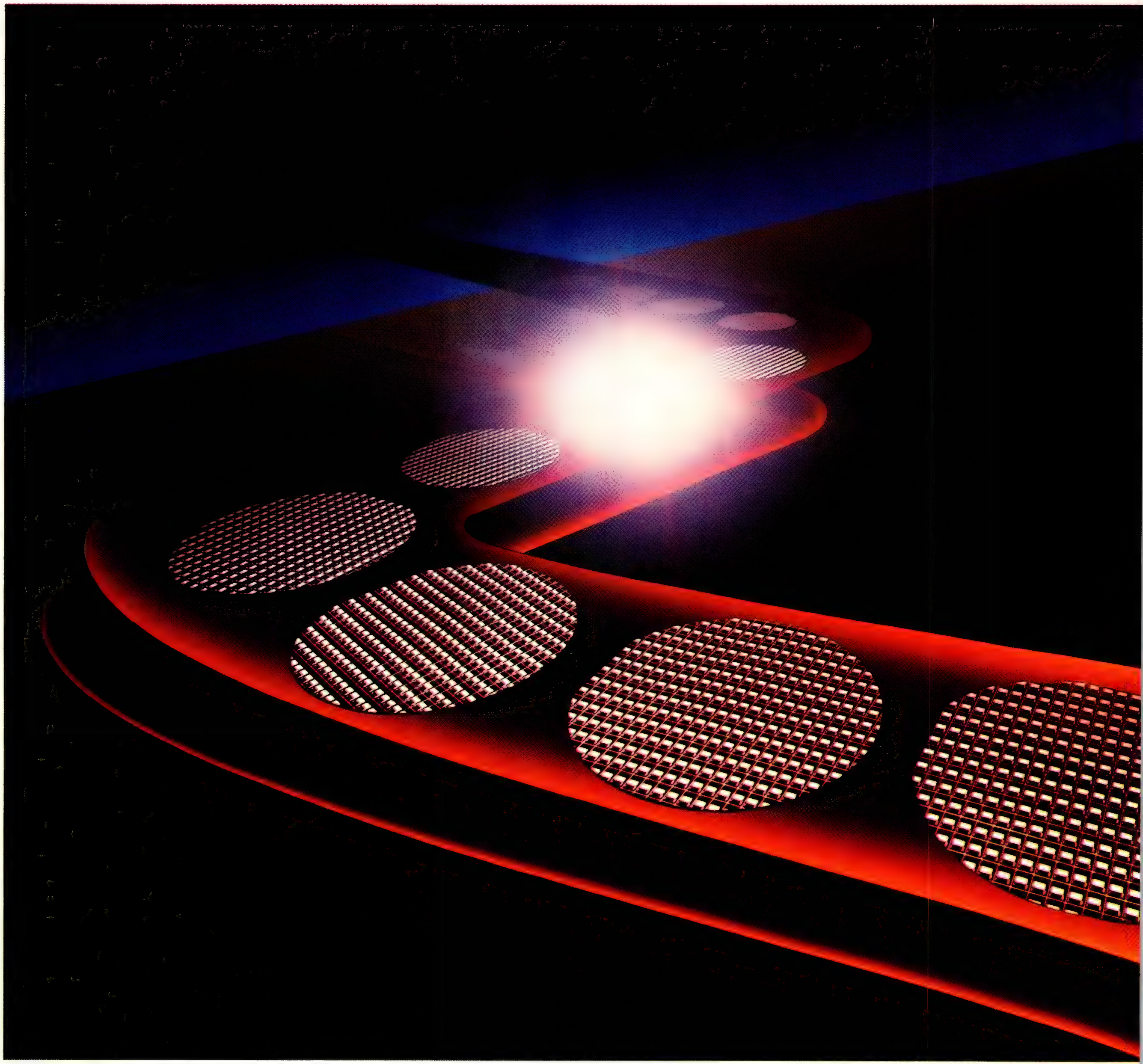

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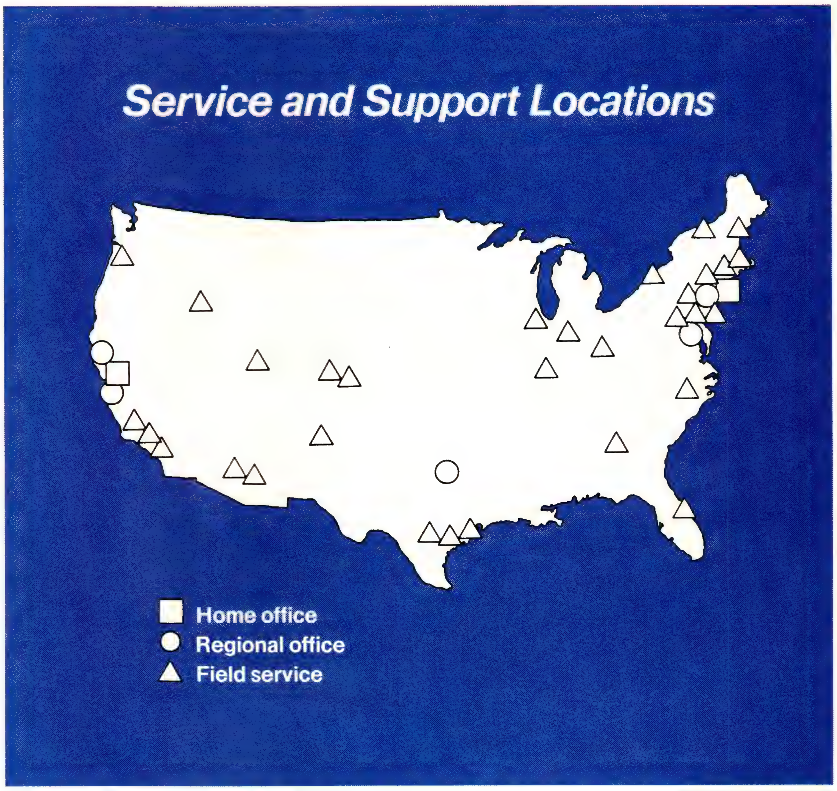

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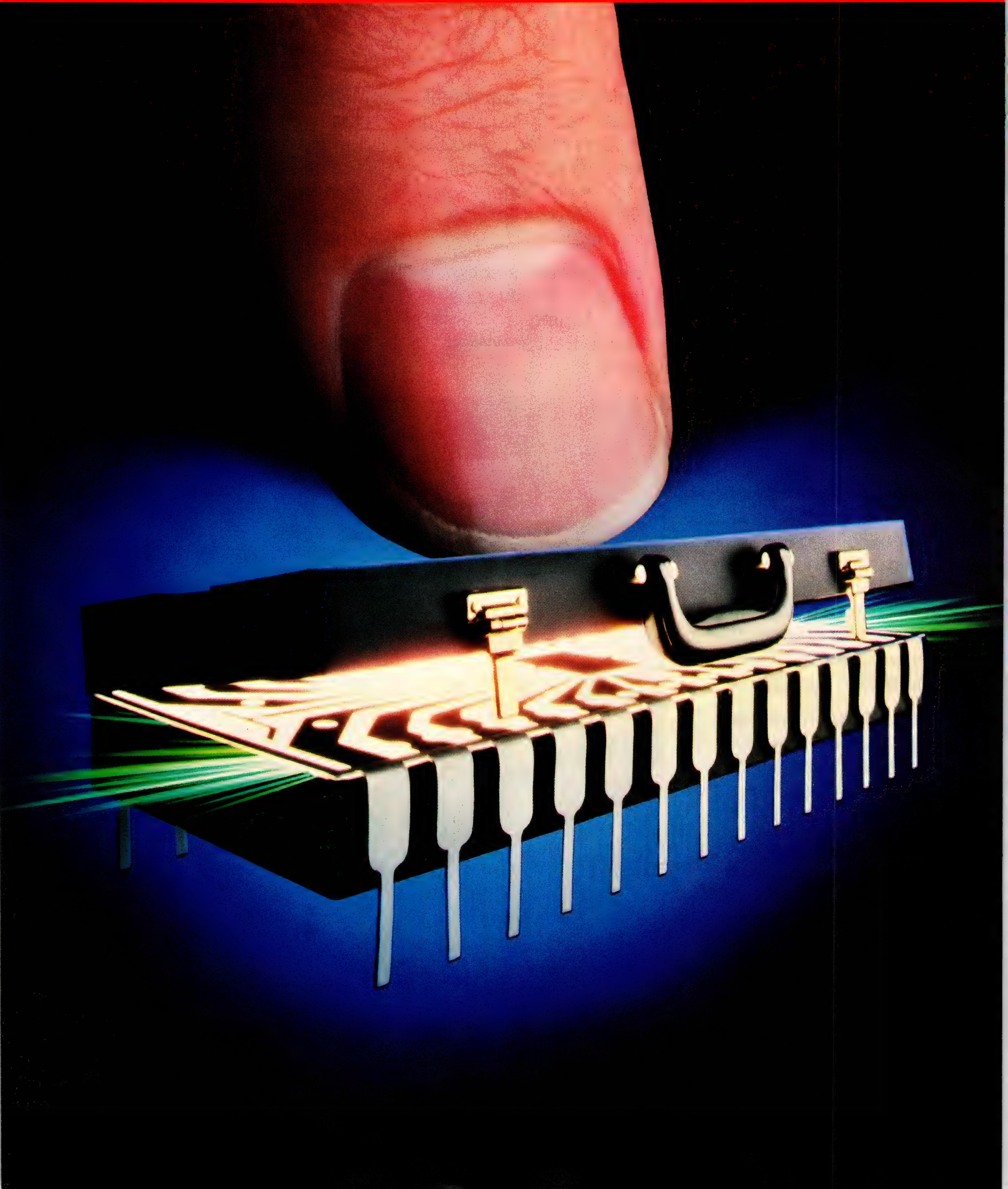

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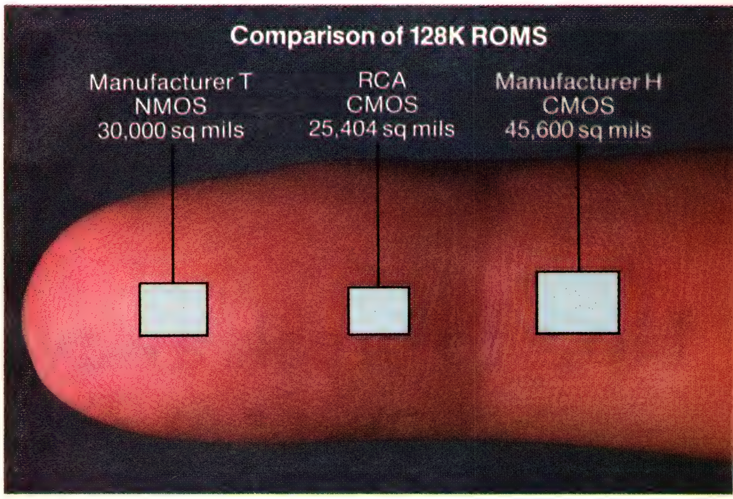

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McDONNELL DOUGLAS FOCUSES ON INFORMATION SERVICES

Palo Alto, Calif.

Hospitals, doctors, and insurance carriers routinely computerize their billing information, but it's up to the patient to see that payment goes to the right place and is properly credited. The patient's check, however, is automatically sent to a clearinghouse, which keeps track of the parties' credits and debits.

A medical clearinghouse that performs a similar service for bills and insurance payments is just one of four operations that the McDonnell Douglas Corp. hopes will make it a dominant supplier of information services.

Confident. "We are going to be a big player" in information services, says McAuto president Robert A. Fischer.

McDonnell Douglas is by no means abandoning its aerospace business, which it expects to double to about $14 billion by the end of the decade. But at the same time, the St. Louis firm wants to increase its current $1 billion in information-services revenues—now scattered in health services, minicomputers, computer-aided design and manufacturing, communications services, and miscellaneous financial services—into a $4 billion provider of turnkey operations for vertical markets.

"We are going to be a big player," says Robert A. Fischer, president of McDonnell Douglas Automation Co. and one of the three directors of the newly organized Information Systems Group.

Tiers emerging. Three tiers are emerging in the computer-communications arena, Fischer says. "At the top will be six or seven giant companies—[such as] IBM and AT&T—that will make 80% to 90% of the general-purpose hardware. They will be strong because they can be low-cost producers.

"In the second tier will be 20 or 30 of us that get our act together and become highly specialized $4 billion to $5 billion companies." Fischer believes the Information Services Group will be sharing the middle tier with firms such as Digital Equipment, Hewlett-Packard, Wang Labs, Control Data, and ADP. The third tier will consist of hundreds of smaller firms developing hardware and software.

The company's strategy was chosen last year after discussions among Fischer, McDonnell Douglas president John F. McDonnell, and Gary Liebl, president of Microdata Corp., Irvine, Calif., a maker of minicomputers and work stations that was acquired by McDonnell Douglas five years ago.

"Last year, we decided to step back and take a look at what was happening with our information-industry activities," Liebl recalls. "There was a lot activity. McAuto [a computer services company] and Microdata were growing, but there was no master plan."

Adds Fischer: "We recognized that there was going to be a shakeout in the information-systems industry, and that we ought to decide what we were really doing. Were we a significant player, or should we think about 'harvesting' the businesses, even selling them?"

They decided to combine all resources into the Information Systems Group and compete in a few carefully selected industries, building each company into a $1 billion business by 1990. McDonnell Douglas Health Systems, built on the firm's existing health-care business, is the first. Others to come will provide services for manufacturing, wholesale and retail distribution, and financial analysis.

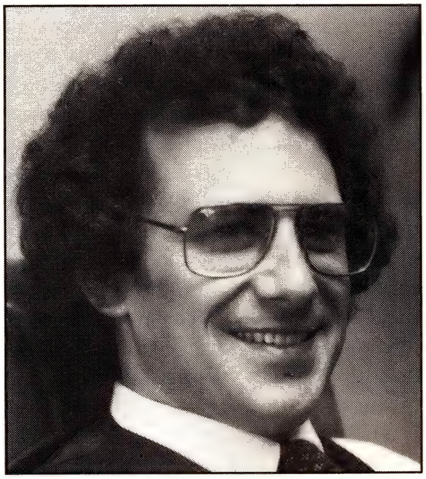
"In the process of working out the plan, we saw the need for linking computers and communications, just as IBM was doing with Rolm, and AT&T by moving into the computer business," Liebl says. "We wanted a value-added network. There were only two, Tymnet and Telenet, and Telenet was already owned by General Telephone and Electronics. Tymnet was our best bet."

Aggressive strategy. After much haggling, McDonnell Douglas bought Tymnet's parent, Tymshare Inc., Cupertino, Calif., for $300 million. "We have aggressive strategic plans for Tymnet," Liebl says. "It is very important to us both horizontally and vertically."

Tymnet, in fact, provides proprietary technology: the communications network to deliver its services. It is a packet-switched network with more than 1,500 U.S. customers and connections to foreign networks.

"A while ago, the key was hardware. Today, it's software," Fischer says. "A few years out, it will be how strong and capable you are in the area of communications."

"I think they have an aggressive



Energetic. "We have aggressive strategic plans for Tymnet," says Microdata head Gary Liebl, part of the Information Systems Group.

strategy," says Randall L. Sherman, a vice president of Creative Strategies Inc., a San Jose, Calif., research firm. "When you approach vertical markets, you're in a sense putting all your eggs in one basket and betting the economies of scale in one market can be leveraged in another."

A good move. "The purchase of Tymshare was a real coup. As the demand for data communications grows—and we are now in the knee of the curve—data communications nets will grow, too. So acquiring Tymnet was a good move. They are now trying to optimize the use of that network. It's probably a very good gamble."

Fischer expects the Information Systems Group to have revenues of $1 billion in its first year: $225 million from McAuto's health services (now switched to the Information Systems Group's new McDonnell Douglas Health Services Division); $100 million from McAuto and Tymshare communications systems services; $175 million from McAuto and Tymshare remote computer services; $40 million from governmental health service accounting; $100 million from a computer-aided design and manufacture unit; $175 million from Microdata; $100 million from Tymnet; and $130 million in financial services from Tymshare.

"We now have strategic task forces in place that will come back to the ISG executive board at the end of the year and explain to us how we can build billion-dollar businesses in the other areas we are targeting—the factory of the future, wholesale and retail distribution, and financial services," Fischer maintains. "We will proceed in parallel. [The Information Systems Group] will be at least a $4 billion business by 1990—as much as all of aerospace in 1983." **–Clifford Barney**

Passives are active at SFE Technologies, as firm links its future to multilayer capacitors

San Fernando, Calif.

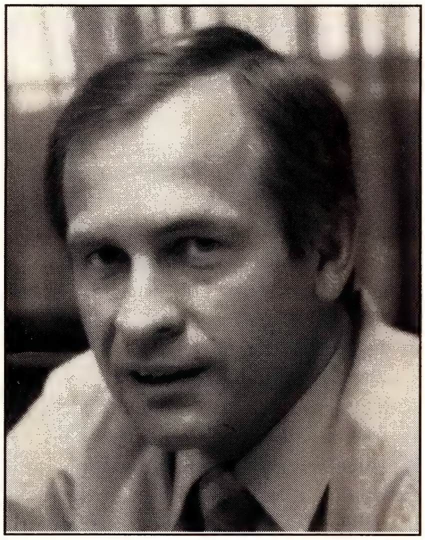
At first glance, passive devices appear a necessary, but unexciting, part of the component business, where integrated circuits get the lion's share of attention. A closer look, however, reveals one class of components so closely tied to IC developments that fast-track growth rewards those able to exploit it.

The driving force is multilayer ceramic capacitors (MLCs), which each logic array requires to protect it from power surges and spikes, as well as to filter out noise. This business is projected to grow at a pace of more than 25% annually, with some segments moving up even faster.

One firm that has linked its future to MLCs is SFE Technologies (known until this decade as San Fernando Electric Corp.), a pioneer in capacitors since 1951. In microcosm, the company's record over the past few years and its future plans sum up the changes taking place in this business.

SFE today is a major MLC supplier, with about $65 million in sales this year and some 10% of the U.S. market. (The leader is AVX Corp., Great Neck, N.Y., followed by Sprague Electric Co., North Adams, Mass., along with several smaller firms.) But SFE was at a crossroad in 1979, stalled in stagnant passive lines, recalls president Alan D. Rubendall. "It was either start to grow, or else."

The decision to plunge into the developing MLC business proved correct, but forced changes in management focus. "We previously were R&D oriented, an acknowledged leader, and took pride in this," Rubendall observes. But MLCs sell cheaply, under heavy competition, so cutting production costs is imperative. "Automation is the thing and we are giving this top priority."


Satisfied. SFE Technologies has "never been tempted to jump into ICs," says president Alan D. Rubendall.

MLCs are fabricated in alternating layers of ceramic material and metal electrodes, a process that lends itself to automation. At SFE, its engineers came up with a Ceramic Advance Production System, which cuts some 75% of the labor cost and raises yields by up to 50%.

Improved efficiencies of this type are vital for SFE to reach its goal of not only growing 30% a year, but also reaching a 10% after-tax profit margin. SFE regards itself as a "premium price company with an eye for the bottom line," not one that buys market share at the expense of profits, Rubendall says. So far, it has not attained its goal of 10% profits, but has reached the 8%-to-9% range. SFE targets the higher margin end of MLCs—for telecommunications and military customers—for about 70% of its sales.

Basking in the glow. Rubendall asserts that SFE has "never been tempted to jump into ICs," which demand different engineering skills, but "likes the glamour associated with it through MLCs." While the tie boosts SFE when ICs boom, there is a downside, too, and the firm has had softening orders since early this year.

"Make no mistake, MLCs concatenate with ICs," notes James Jeffs, financial analyst for Siedler Amdec Securities Inc., Los Angeles, who follows SFE's fortunes closely. Jeffs believes that SFE's high-margin strategy makes it a good investment prospect "and investments in automating are the right thing [for the firm] to be doing."

Despite the present slowdown, Jeffs expects SFE to grow at a higher rate than the MLC field as a whole, as these investments pay off. He and Rubendall differ on the outlook for increased Japanese competition, however. The SFE executive sees these firms lacking the special upper-end MLC technology needed to penetrate the market. But Jeffs thinks this competitive move will happen in several years. **–Larry Waller**

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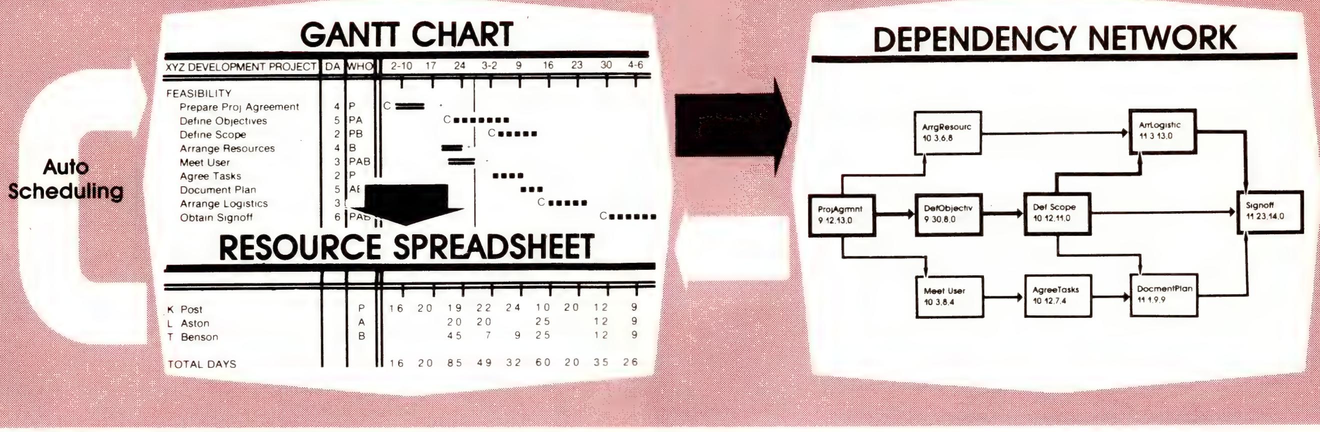

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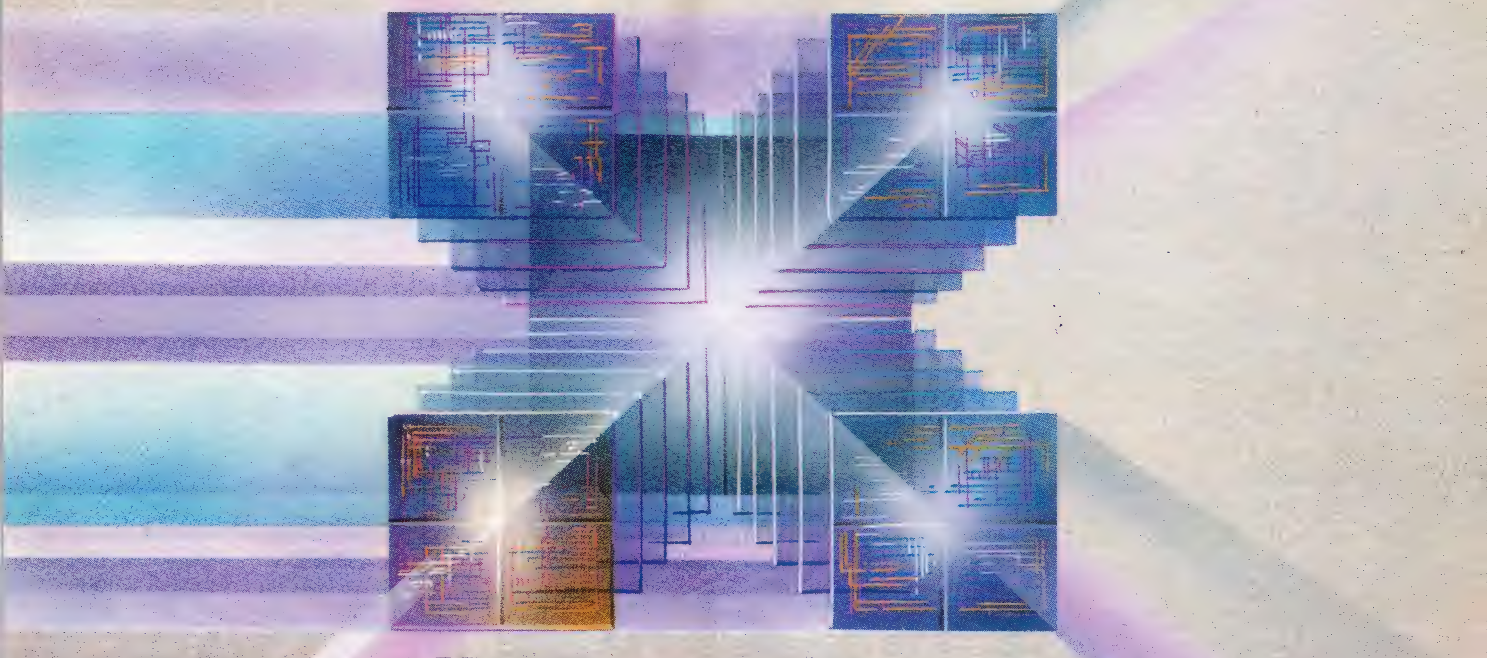

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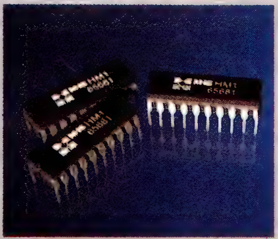
MHS introduces the first 16 K static memory with dynamic activation HM 65681.

The design approach is in itself an achievement, bringing together the advantages, hither to irreconcilable, of the speed of NMOS and the power consumption of CMOS in a single circuit. The new memory by MHS now makes available the performance benefits of these combined technologies.



Organized as 4096 words of a 4 bits, the design is completely new and it is the first all-pulse 16 K memory on the market.

Principle of operation:
A sense detection stage changes in level at the pins (commands and addresses) and transmits a pulse element to a controller which generates different signals of optimum width to ensure dynamic validation of the internal functions of the memory.

Result: The best compromise between speed and power consumption available on the market.

With a 10 MA/ICCOP specification, the 4 K x 4 far outclasses the competition for speed versus power consumption, over the whole range of temperatures from − 55 to 125 degree C. MHS also guarantee 55 MW consumption at 70 degree C., which gives an average well below standard products, proportional to the frequency of use.

Finally, this new memory, like all the other members of the MHS 16 K family, has a select chip controlled input structure, which gives it a low quiescent power consumption at intermediate voltage levels (VIH).

4 K x 4 format: greater design flexibility + higher speeds.

The original configuration of this new memory gives designers two important advantages:
– great flexibility in application through the reduction in package size – only 20 pins compared with 24 for the 2 K x 8 half the size but the same memory capacity.
– high speed in operation because the capacity of the input/output buses, which is normally a performance – limiting factor, is compensated by optimised output buffers. The number of buffers and bits being the same, performance goes up and size goes down.

The technical features make this memory particularly suitable for military (radar/sonar, guidance systems, aiming systems) and DP (file memory) applications.

Performance chart of the HM 65681 memory.

HM 65681	*0°C to 70°C*	*− 55°C to 125°C*
Access time	*55*/70/85*	*70*/85/100*
Operating supply current Iccop at 1 MHz	*10 mA*	*15 mA*
Standby current		
• Iccsbl at $\overline{CS}$ = Vcc–0.3 V	*50 µA*	*900 µA*
• Iccsb at $\overline{CS}$ = VIH	*3 mA*	*4 mA*
Package	*20 pin plastic, ceramic, LCC*	

**Introduction Q1/85*

dp-industries

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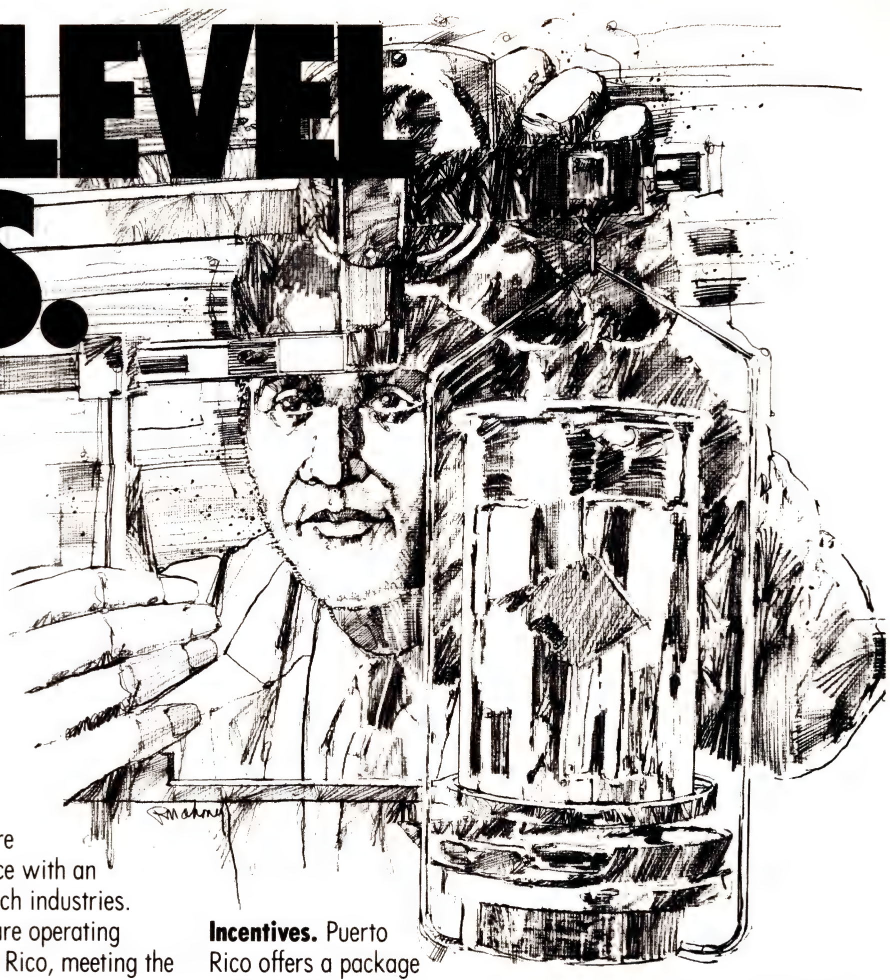

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Circle 123 on reader service card

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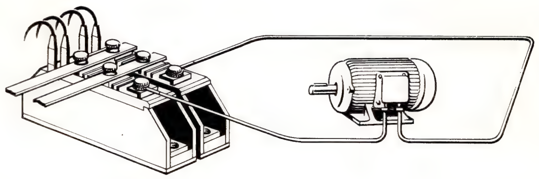

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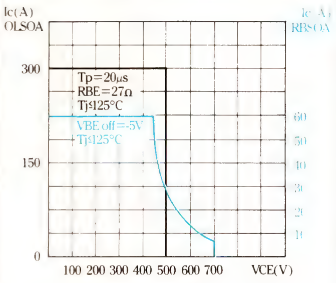

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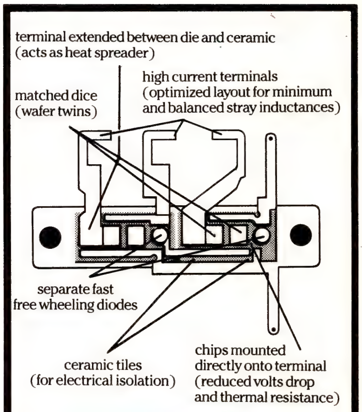
terminal extended between die and ceramic (acts as heat spreader)
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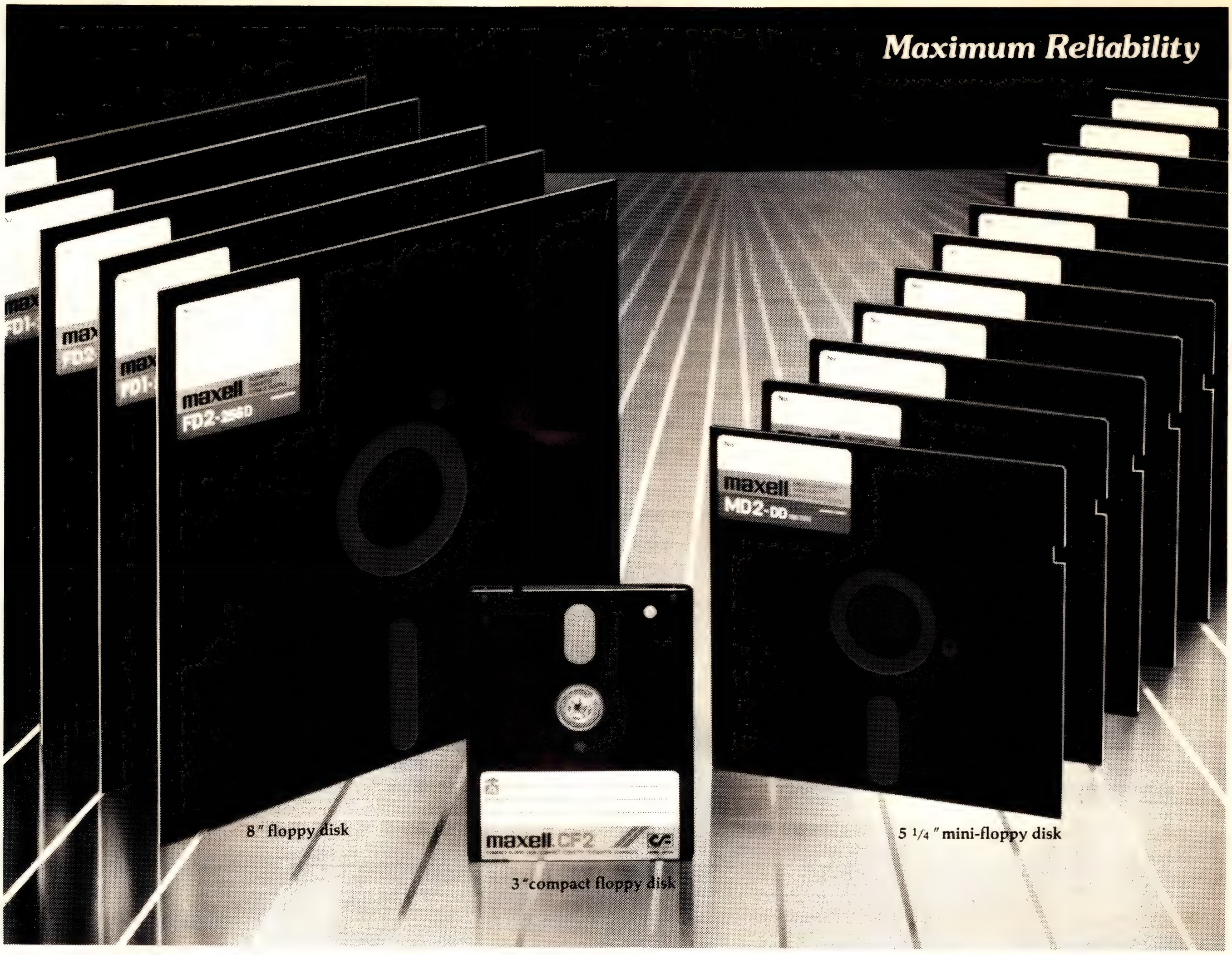

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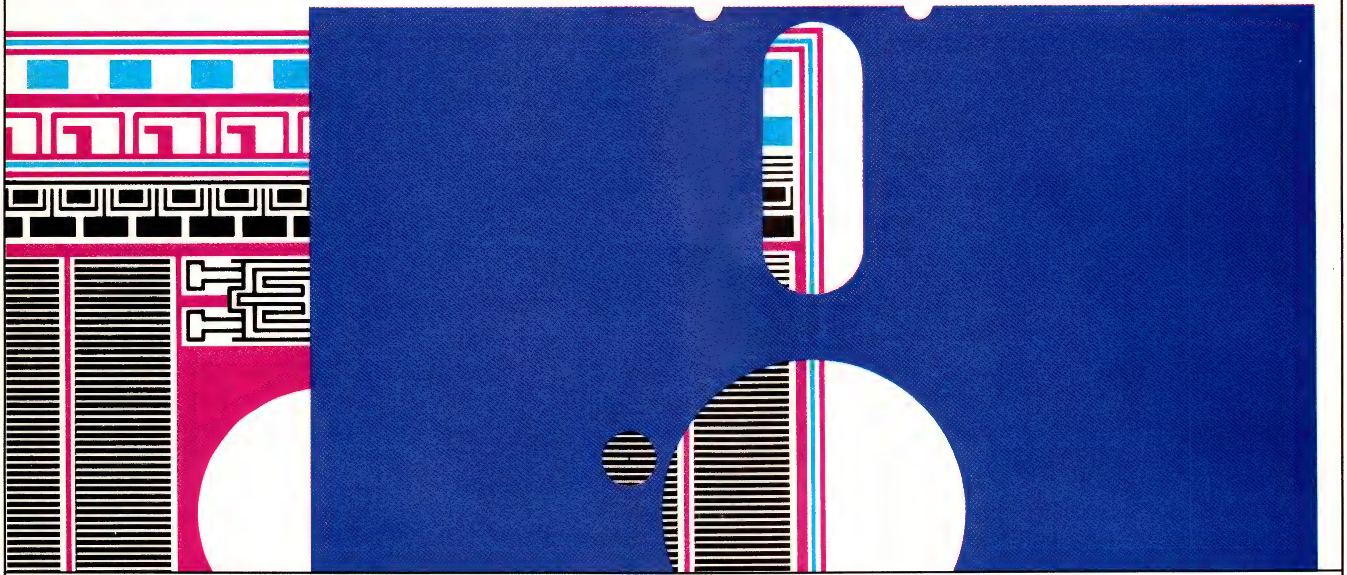


ROM SOFTWARE IMPROVES SYSTEM RELIABILITY

Software based on read-only memory strengthens the interaction between programs and hardware in a computer system

☐ *by Thomas M. Dille, John Katausky, Kathryn S. Norris, and Kurt Robinson*

In response to the demand for more reliable systems with greater capability, system designers are integrating sophisticated ROM-based software packages and microprocessors. In the most highly integrated systems, engineers count on software in silicon—complete software packages in read-only memory—to provide a degree of dependability generally associated only with hardware circuits, while maintaining the flexibility of traditional software programs. To reach this combination of advantages, system engineers balance special software-design techniques with selected hardware circuits.

Advances in central-processing-unit and storage technology have equipped engineers with a wide choice of tools for building sophisticated systems at relatively low cost. For example, system vendors can combine powerful microprocessor chips and dense semiconductor memories with high-capacity storage in the form of disks, to offer desktop machines that edge into the performance range of a minicomputer but stay at the price level of a personal computer. In these types of systems, disks serve as the central storage medium for system and application programs as well as for user data.

On the other hand, disks are often not the preferred storage method; in some systems—such as in computers operating in harsh environments, or in portable computers with limited (or no) disk storage—they can't even be used. In embedded systems, the microprocessor is only a small part of the total product—such as an automobile or appliance—and a disk is not among its available resources. Consequently, whether it's because they can't use disk storage or because they prefer not to, designers can draw on silicon software to provide software routines that the CPU can access efficiently.

Silicon support

Designers can find silicon support for software in a variety of forms that span a range of complexity from chips that passively store programs to those that actively cooperate with software processes (Table). Furthermore, between these extremes lies a family of systems that combines on-chip software with some limited hardware to support specific application areas.

Although the boundaries between categories often blur, in general silicon-in-software parts offer a set of well-defined procedures in their large on-chip ROM arrays. Current software-in-silicon products include chips with a complete Basic interpreter, a general-purpose operating system (CP/M-86), or even the kernel of a real-time operating system (RMX-86) contained in on-chip ROM.

In addition to the software in ROM, silicon software parts such as Intel's 80150 CP/M-86 and 80130 RMX kernel chips bolster their software support with special-purpose hardware for specific functions (Fig. 1). For example, timers on the 80130 and 80150 replace the software counters typically used in system software for various real-time operations.

Nonetheless, regardless of their physical characteristics, software in silicon is often more appropriately defined by the benefits and capabilities that it brings to a system. As one of its primary benefits, software in silicon provides greater system reliability because the CPU does not have to rely solely on volatile system memory, or disks, to hold programs. As a result, even if a power failure should bring the system to a halt during execution, silicon software always ensures a reliable copy of the programs when the CPU restarts.

In addition to improving reliability in completed systems, software in silicon provides a set of ready-made procedures and services for application areas. It thus helps system developers concentrate on creating new application solutions, rather than on recreating the base set of utilities needed to build the application. Furthermore, by providing a stable interface between an application and a shifting hardware base, software in silicon also helps engineers quickly transport application software to new generations of microprocessors. For example, real-time applications layered on the 80130 RMX real-time kernel can move easily among Intel's family of processors such as the 8086/8088 or 80186/80188.

The interface provided by software in silicon is particularly important in creating special-purpose embedded systems, where often a single chip works with a minimal set of associated hardware. Rather than being confronted with just a set of chips, engineers find a user interface in silicon software that helps them move quickly into the implementation of a target system. Because the 8052AH-Basic chip builds its support on Basic—an interpreted language—it presents engineers with a complete development and execution environment.

Besides offering a conventional Basic interpreter on chip, the 8052AH microcontroller extends support to embedded systems through a combination of dedicated hardware and Basic software commands that are cognizant of the real-time environment. One of the most critical resources in the real-time environment is time, and the 8052AH handles this resource through an on-chip real-time clock and a set of Basic commands.

Programmers can enable or disable the clock with a pair of Basic statements—CLOCK 1 and CLOCK 0, respectively. When the clock is running, they can also reset it to a new value—say, x—with a standard Basic assignment statement such as TIME=x, or display its results with other statements, such as PRINT TIME.

Even this extra support for handling time would be of little use if the chip did not account for the asynchronous and random nature of events. An application might require servicing every second, even though the embedded system designed to handle the application is also simultaneously performing some other tasks. In this case, a programmer would use another special 8052AH instruction—ONTIME. For example, 1 second after execution of the statement ONTIME TIME+1.0,1000, the 8052AH would call a subroutine located at line 1000, regardless of its current activity. The programmer could ensure that the 8052AH executed the subroutine every second by including the same ONTIME statement at the end of the service subroutine.

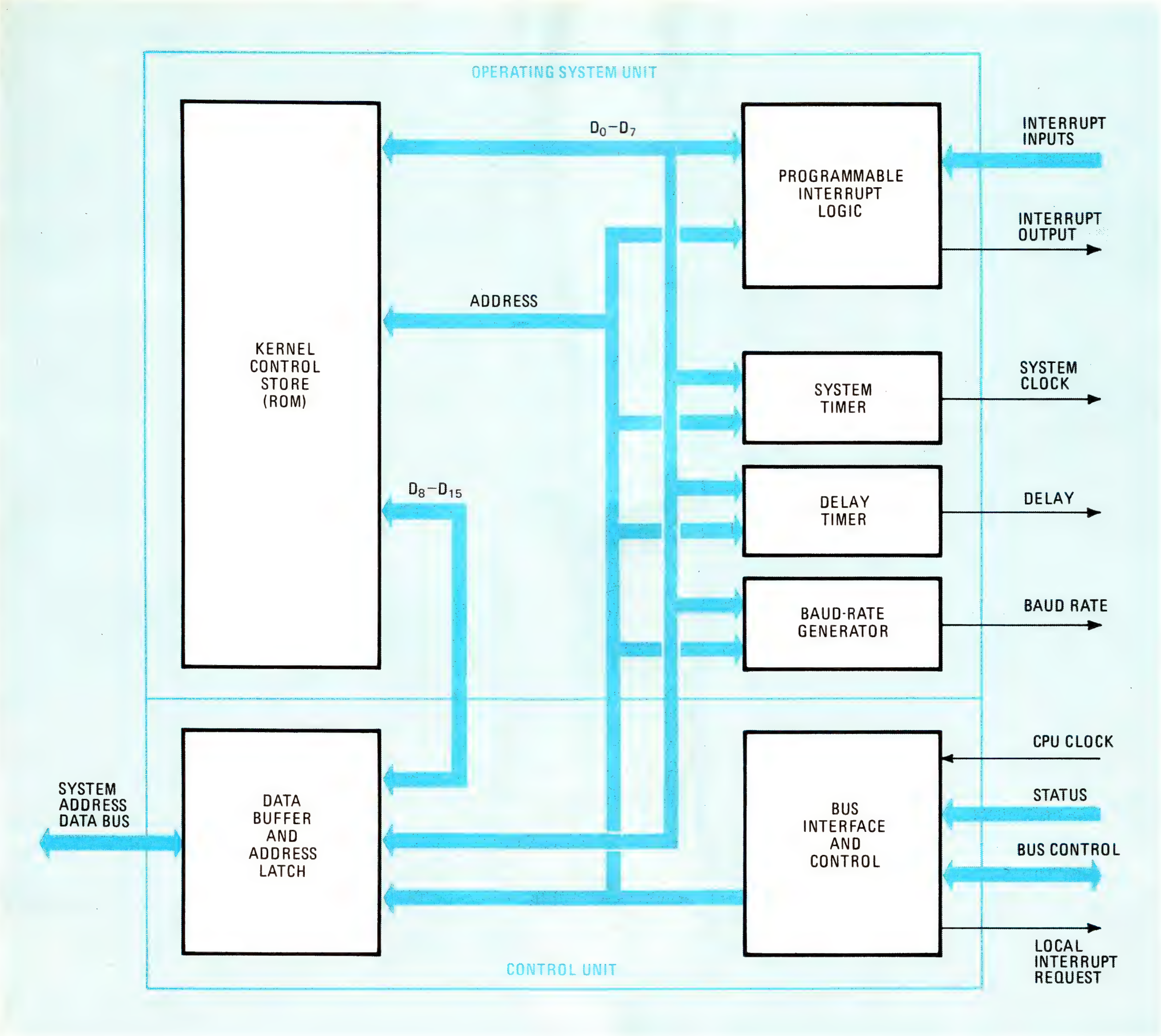
Asynchronous processing

This kind of asynchronous processing of external events, or interrupt processing, shares the spotlight with time management in real-time systems. Special-purpose software such as RMX includes a number of statements for handling interrupts and finds its own support for these utilities in the 80130 software-in-silicon component. The 8052AH-Basic chip, on the other hand, augments the set of commands conventionally found in Basic with a statement designed to permit the 8052AH to react to external events. Acting much the same as the ONTIME statement, an ONEX1 statement such as ONEX1 2000 causes the 8052AH to jump to a subroutine located at line 2,000 when an external device pulls the 8052AH INT1 input pin low.

All software-in-silicon components—even a microcontroller with on-chip software and hardware for handling time and interrupts—need to work within a larger context of a system. For example, embedded systems built around a set of standard software-in-silicon components need some external user-programmable ROM to hold the

TABLE : METHODS OF SUPPORTING SOFTWARE IN SILICON

Medium	Description
PROM	CPU loads system memory from PROM (solid-state disk)
PROM	CPU executes code directly from PROM
PROM with on-chip hardware	CPU executes code directly from PROM and uses hardware for related functions
VLSI processor (with on-chip memory)	Hardware implements software algorithms



1. Operating system firmware. In silicon-software components, a large read-only memory array holds software routines. The 80150 and 80130 include timers, bus interfaces, and an interrupt controller to respond to the demands of the software—CP/M-86 and RMX-86.

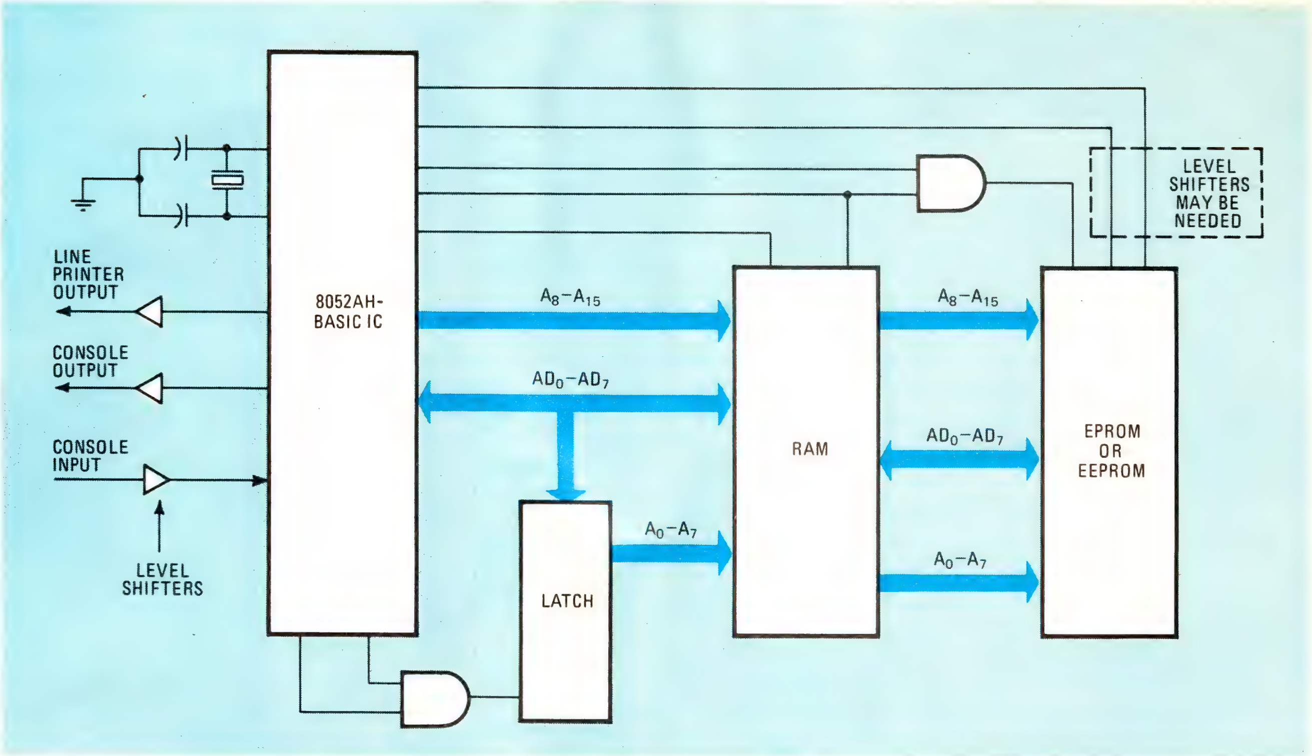
applications programs that call on the silicon-software utilities as well as some external random-access memory to function as working memory. With the additional extensions to Basic found in the 8052AH, engineers can coordinate the interaction between this external memory and the microcontroller itself (Fig. 2).

A language such as Basic is a likely target for a silicon system, because it is a popular interpreter that can be implemented in a relatively small amount of memory. In fact, because the same utilities operate both during development and in the final production system, both developers and users can make use of its features. A noninterpreted language, such as Fortran, is a less likely target for integration into silicon, because a full Fortran compiler is a large software program that would only be useful during development of Fortran programs, rather than during their execution. Because users execute Fortran programs significantly more often than they compile them, a compiler in silicon would offer minimal utility.

On the other hand, operating systems are software packages that are used frequently both by users and by their applications software. Still, a software component for an operating system—or portions of an operating system—presents a significantly different set of requirements than that for an embedded system. Unlike a dedicated system, for example, a software-in-silicon version of a general-purpose package must account for a broad range of hardware configurations that engineers might build around silicon components, as well as for custom software packages that designers might use instead of the standard routines supported in silicon.

Flexible silicon

The inherent stability of software in silicon ensures high reliability and a consistent interface with the applications program. Nevertheless, these systems maintain the flexibility needed to work efficiently with software. For example, with components such as the 80130 and 80150, engineers can use the same software-in-silicon components in different hardware systems, regardless of



2. Embedded system. With external random-access memory and electrically erasable programmable read-only memory or EPROM, the 8052AH-Basic controller is a stand-alone system. Commands select RAM or ROM and transfer programs to RAM or save them in EEPROM.

the target system's memory size or the types of input/output devices. Similarly, these chips permit designers to add their own custom software to its set of utilities.

Most software in silicon components, including the 80130 and the 80150, manage this flexibility by working through tables on the component itself and in system RAM (Fig. 3). During an initialization phase, software routines on the chips create a configuration table in RAM of system-related variables—such as the amount of memory available or the types of I/O hardware. Consequently, rather than using a hardwired ROM-based parameter for the size of an input buffer, for example, the software-in-silicon routines use a default value that is loaded into the configuration table during initialization. As a result, programmers are free to alter this value with their own programs if they decide that the system needs different buffer sizes.

Just as the configuration table enables engineers to tune software in silicon to different hardware systems, it is also the main reason that they can augment or modify standard software services. During system initialization, besides setting up system parameters in RAM, the packaged routines also build a table of references to ROM-based software in system RAM. Rather than referring to routines at their specific locations in ROM, applications programs issue requests for services indirectly through this table. Consequently, system designers can substitute their own custom software for ROM-based software by placing the address of their own routine in the appropriate location in this address table in system RAM.

Although this technique adds a level of indirection for service calls, its effect on overall system performance is minimal. Compared with the time generally required for handling computational algorithms associated with an application, the time spent in actually calling system services is negligible in most systems.

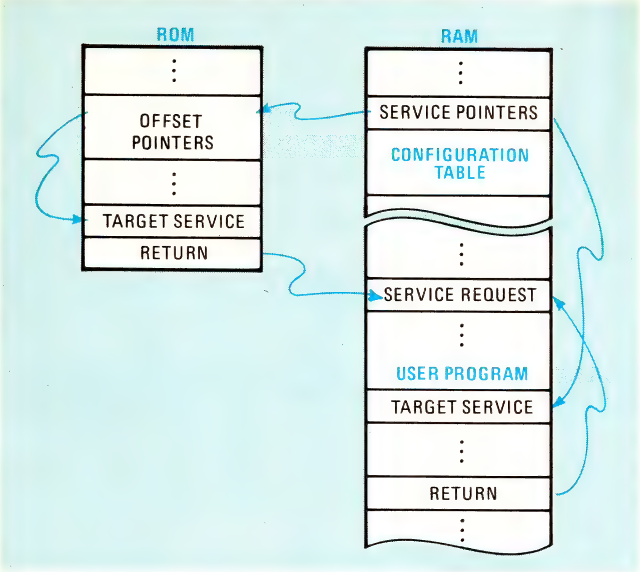
In addition to ensuring that the software in silicon remains independent of the particular hardware configuration or custom code, this technique of indirection provides a means for the component manufacturer to ensure that applications will remain compatible with new versions of the software in silicon. Just as applications refer to a configuration table in RAM, the configuration table, in turn, refers to a table on the chip, rather than specific addresses in the ROM.

Even if a new version of the silicon component changes the specific starting address of a routine in ROM, the routine's pointer—expressed as an offset in a table in ROM—remains at a fixed location in the ROM's pointer table. Consequently, applications can address a routine in silicon indirectly through the pointer, which will remain at a fixed offset in the table regardless of whether the new version has changed the address of the associated routine in ROM.

Modules and maps

Silicon-software vendors use these indirect-reference tables to ensure that their ROM-based software survives updates and version changes. In addition, in order to create a package of software components that can fill the widest set of needs, these vendors must be sure that their code can exist in any location in a system's address space. Achieving this kind of position independence, however, is typically handled by standard tools of the software development environment, including assemblers, compilers, and linkers that produce relocatable code.

Besides being sure that code can exist anywhere in the system memory map, designers must also construct sili-



3. Indirect references. Application programs refer to pointers in random-access memory, which refer to pointers on silicon software. Thus users can substitute their own code and be assured that their applications remain compatible with new versions of silicon software.

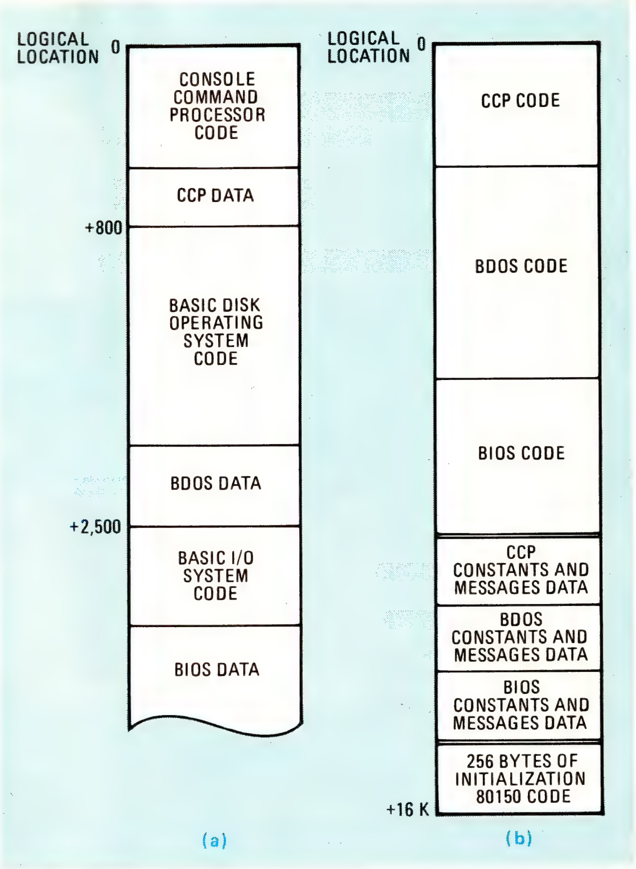
con software modules in a such a way that the code can be executed from ROM. Specifically, data and code modules must be explicitly separated—which sometimes requires reorganization of existing packages.

Standard disk-based CP/M-86 mixes both initialized and uninitialized variables in one long structure, which comprises all code and data modules (Fig. 4a). The system's console command processor handles command-line processing and executes its own built-in utilities, while the basic disk operating system manages logical disk access and the basic I/O provides configuration-dependent information as well as low-level I/O services. To fit this system onto silicon, the 80150 designers extracted code and constants for these three components of CP/M-86 and collected them into a contiguous structure that could fit in about 16-K bytes of ROM (Fig. 4b). During system startup, an 80150 initialization routine builds its configuration and address tables and places CP/M-86 variables into system RAM.

Perhaps the key ingredient in successfully creating a set of software-in-silicon components is determining what to put into silicon. In parts built around existing software designs, such as Basic or CP/M-86, the designer already has a clear goal. But support for other types of systems, such as a real-time operating system, requires a more calculated estimation of silicon's optimal use.

With Intel's RMX real-time operating system, for example, engineers can utilize a wide range of capabilities, from file management to multiprocessor support—capabilities that not every real-time system would need. Consequently, a software-in-silicon component such as the 80130 contains just the primitive services—the kernel—that are needed in every real-time application. As a result, an embedded system based on RMX can use the 80130's support for multitasking, intertask communications, interrupt, and exception handling.

When combined with an 8086/8088 or 80186/80188, the 80130 forms an operating system processor (Fig. 5) that is compatible with the more extensive features available in RMX 86. In fact, because the 80130 (as well as the 80150) can monitor the system clock and three status lines from the microprocessor, it can decode the processor status internally and respond automatically to the appropriate bus cycles. Thus they can both operate at a rate as high as 8 MHz with no wait states—a clear advantage over slower erasable-programmable-ROM-based implementations of software in silicon.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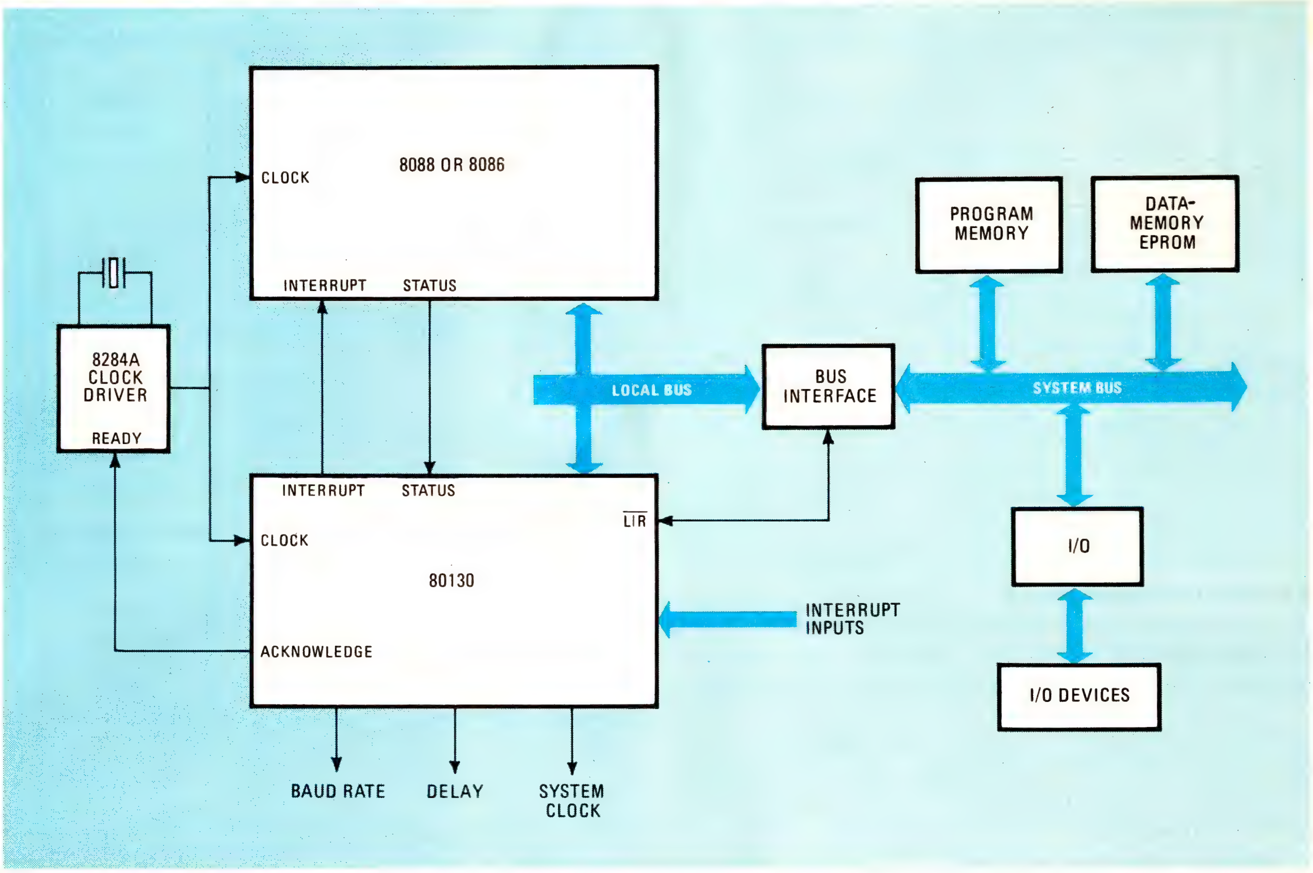
0
CONSOLE COMMAND PROCESSOR CODE
CCP DATA
+800
BASIC DISK OPERATING SYSTEM CODE
BDOS DATA
+2,500
BASIC I/O SYSTEM CODE
BIOS DATA
(a)
LOGICAL LOCATION
0
CCP CODE
BDOS CODE
BIOS CODE
CCP CONSTANTS AND MESSAGES DATA
BDOS CONSTANTS AND MESSAGES DATA
BIOS CONSTANTS AND MESSAGES DATA
256 BYTES OF INITIALIZATION 80150 CODE
+16 K
(b)

4. Software shuffle. Although the original disk-based CP/M-86 can intermix code and data (a), the 80150's implementation separates code from data modules (b). Code stays in the 80150's 16-K-byte ROM, while system variables go in a reserved area of system RAM.

Extra RAM

Like the 80150, the 80130 requires some off-chip RAM for use as its own working memory. In addition to at least 1-K byte of RAM for interrupt vectors, the operating system processor needs approximately 1.5-K bytes of RAM for the stack and assorted system variables and data structures—along with about 300 bytes of RAM for each application task's stack. Other than these requirements—and approximately another 1.5-K bytes of initialization information—the 80130 can exist on any 16-byte boundary of the microprocessors address space (except the extreme top or bottom). During system startup, the initialization code creates the configuration and pointer tables.

Although in many types of software-in-silicon systems the initialization phase creates critical tables of system parameters and address references, in less complex uses of software in silicon a specific initialization phase is



5. Silicon operating system. The 80130 RMX kernel chip coordinates with processors such as the 8086/8088 or 80186/80188. This forms an integrated operating system processor that can execute code in the 80130 at 8 MHz, with no wait states.

unnecessary. In equipment with minimal storage requirements, dense EPROMs serve as an optimal storage medium. For example, the system might include dense EPROM chips to store specific applications, such as a spreadsheet. When the user desires to execute the application, the CPU can load the software into its system RAM from EPROM, just as it would load it from disk in a larger system.

Also, when EPROM acts as a solid-state disk, software engineers can create their own software-in-silicon components, where the CPU executes code directly out of high-density electrically programmable ROMs. Direct execution from EPROM permits a very simple user interface, with programs silently and quickly executed at the touch of a function key. EPROM program storage is the standard in critical applications such as hospital bedside monitors or central stations where the application demands immediate code execution, as opposed to bootstrapping and loading from disk.

In addition to the added reliability of EPROM-based systems, they offer a measure of security to software vendors' programs. At the simplest level, software in EPROM is less vulnerable to piracy by the casual copier, who often does not have access to the kind of equipment needed to extract software in this form. In addition, vendors can exercise some active protection against piracy. For example, a simple control circuit can detect the type of access cycle issued by the microprocessor through its status lines and enable the chip only if the processor is in an execute cycle, rather than a read-data cycle. This prevents copying application-program code out of the system as if it were RAM data.

As in available parts such as the 8052AH-Basic, 80150, or 80130, the critical requirement in using standard EPROMs is to ensure that the code remains position independent, configuration independent, and insensitive to updates. By building this kind of configuration and indirect-reference tables, software engineers who are designing their own application-specific software to be programmed into EPROM can easily meet this requirement. In addition, these techniques permit them to incorporate bug fixes without reprogramming the entire EPROM. Thus, for example, if they should discover an error in an existing EPROM routine, they can simply place the corrected version of that routine in RAM and update the indirect-reference table to refer to the correct routine in RAM, rather than the erroneous version in EPROM. Then, after they assure themselves that they've caught any errors, they can reprogram the EPROM to include the current versions and use the configuration table to reflect this update. ☐

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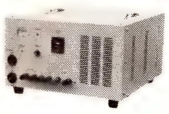
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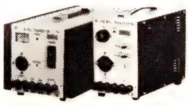
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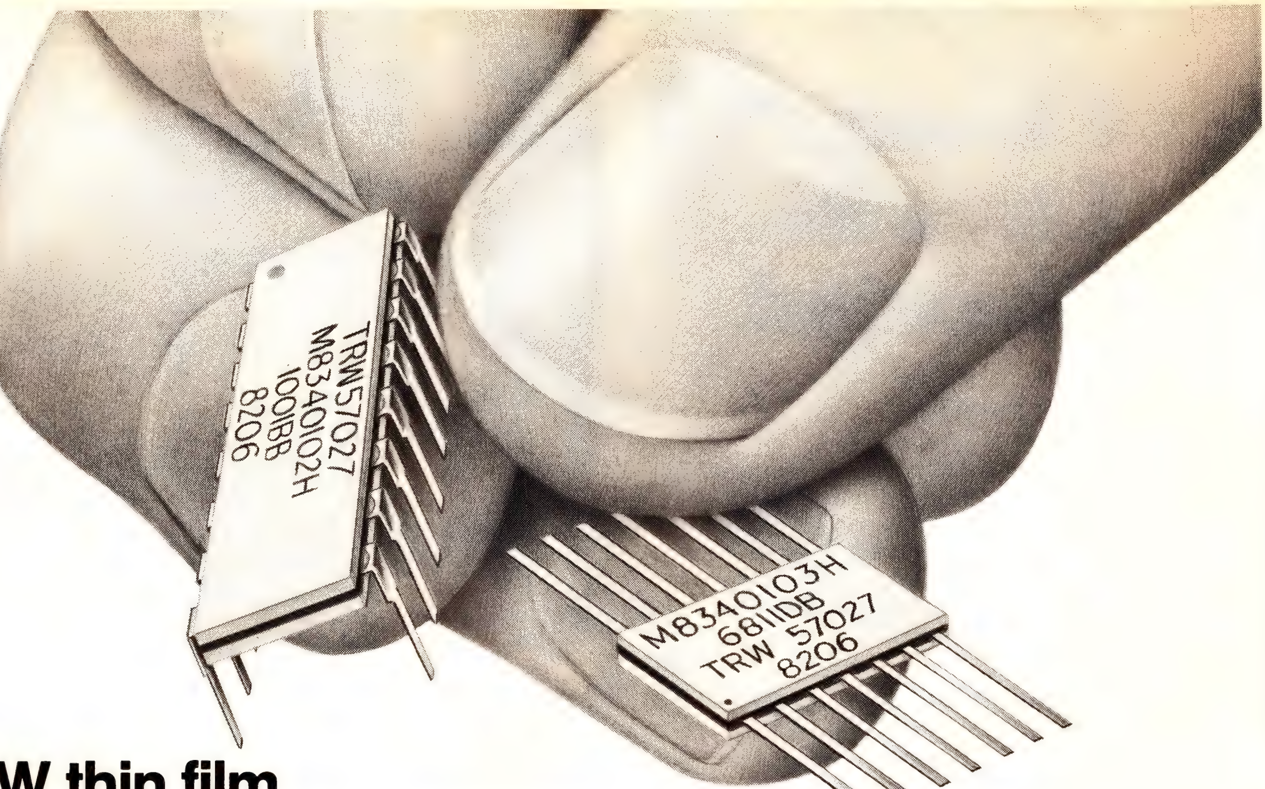

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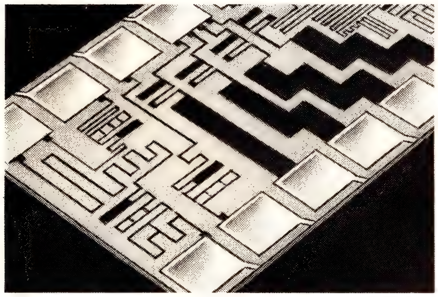

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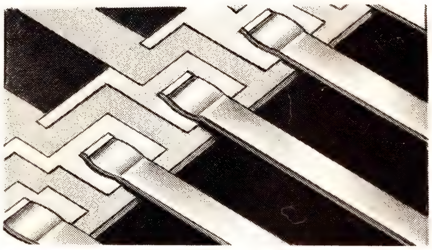

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☐ *by Brent La Reau*

Uses for wireless keyboards are cropping up every day as designers start to incorporate them into their creations. The IBM Corp. PCjr's keyboard is one of the first battery-operated infrared wireless units on the market, and this feature has sparked considerable interest in the computer industry.

Videotex and similar interactive system designs can also benefit from a wireless keyboard. Whether the videotex unit is a separate component or built into a TV, there is no convenient place for a cabled keyboard. Moreover, voltage drops due to the cable's wire resistance could affect system performance, and the long cable can pose a safety hazard for people walking in the area.

This is also true for home computer systems, which are often placed haphazardly, such as on top of a TV console with other video paraphernalia, such as a VCR or cable converter. The wireless keyboard allows the computer user to sit in his usual place in front of the TV while using his computer.

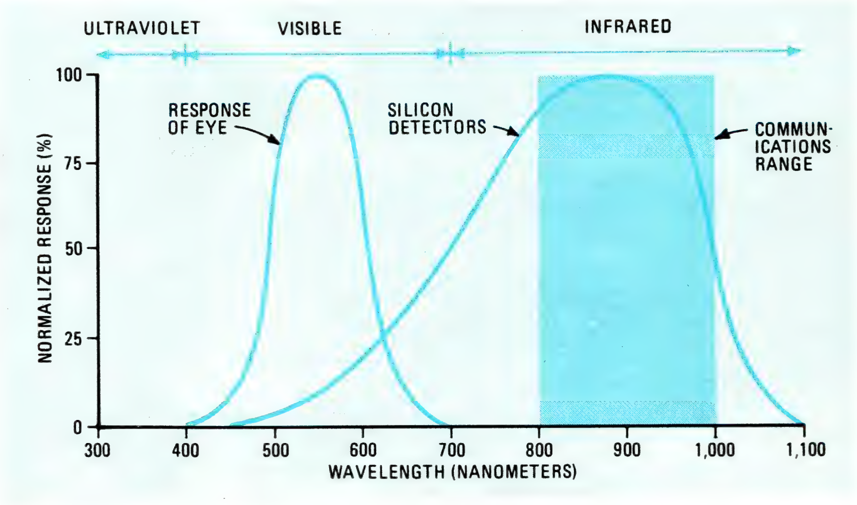
Another popular use for a wireless keyboard is in computer-aided presentations, where the computer is connected to a projection-TV system. Participants seated around a conference table can each use a wireless keyboard to manipulate data as they join in the discussion. The wireless keyboard can also be used for remotely updating information displayed on digital signboards mounted at inaccessible locations.

The advent of the IR keyboard dictates a new look at IR data communications. A computer keyboard is used differently than a TV remote control and must be more reliable: keystrokes must be received correctly, or something more disastrous than a wrong television channel change will occur. The typical television remote control is pointed directly at the receiver: if the received signal is garbled, the user will know immediately by the lack of the desired reaction from the TV set. The computer user, however, must be alerted audibly if the signal is not being received correctly; otherwise, he must look at the computer display at all times to make sure the keystrokes that are being entered are reaching the computer.

IR advantages

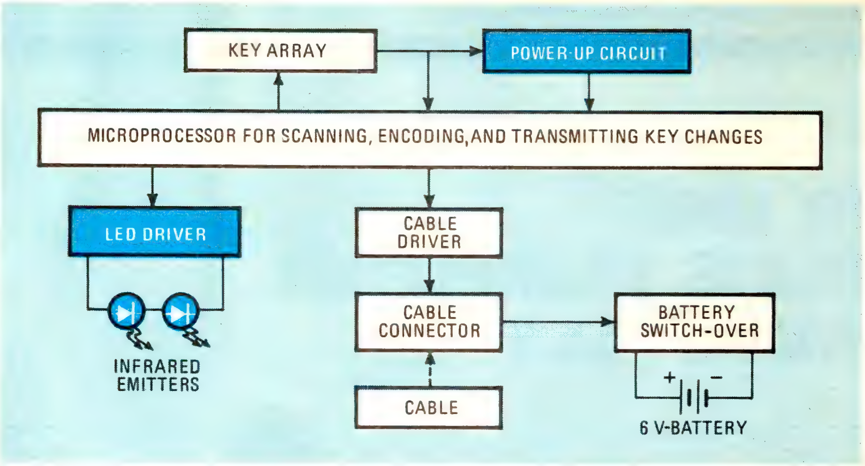
Infrared radiation used for communications lies roughly in the 800-to-1,000-nm range of the optical spectrum (Fig. 1). This corresponds to the normal emitting range of commercially available IR light-emitting diodes, which function in either of two wavelengths, depending on the type of dopants used during device fabrication. Gallium-aluminum arsenide LEDs, for example, exhibit a typical wavelength of 880 nm and gallium arsenide LEDs radiate in the 900-to-950-nm range. The newer super-bright IR LEDs on the market are generally GaAlAs.

The frequency range of IR devices offers some unique advantages. First, IR LEDs are generally more efficient than visible LEDs because more development activity has



1. Optical wavelength region. Infrared radiation lies in the 800-to-1,000-nm range and is invisible to the human eye, which peaks at only about 550 nm in the visible spectrum. Silicon detectors, which are wideband, peak in the infrared region.

2. Infrared keyboard. An IR wireless keyboard contains the same basic circuitry as a standard computer keyboard. But it also includes an IR transmitter and batteries, as well as circuits to supply power to the keyboard when a key is pressed.



been expended in this area. Second, less ambient modulated IR energy is present than ambient modulated visible energy, since our light sources were designed to be efficient in the visible spectrum, not in the IR or ultraviolet spectrum. The IR energy present in our environment—such as that generated by the sun or by incandescent lighting—is mostly continuous (unmodulated) and poses little problem for optical communications as long as it isn't too intense.

Third, rugged and inexpensive silicon photodetectors exhibit peak response in the red-IR range and are therefore inherently compatible with IR LEDs. Finally, 800-to-1,000-nm wavelengths are not readily absorbed by materials commonly used for walls, floors, and furniture, but are reflected by varying degrees. This greatly increases the signal level at the detector as a result of the summation of multiple received beams. An RF signal might go through a wall to an adjoining room and cause interference, but the IR signal stays within its own area.

Design considerations

The IR free-space communications link is not without its difficulties, however. The link must function over a very wide range of distances and beam angles. Typical operating distances range from under 1 in. to over 20 ft, with a 57,600:1 change in signal strength between these extremes. This ratio can be even greater, since the received signal strength depends on the transmit and receive angles with respect to the devices' optical center—the received signal drops off sharply as both angles are increased. Thus the receiver must operate reliably at both extremes of signal strength.

Even though wireless keyboards are unlikely to be more than 10 feet away from the receiver, primarily because of the difficulty in reading a typical computer display from that distance, the IR link must transmit and receive from various angles and longer distances. Although the usual expected operating range for an IR computer keyboard is between 1 and 10 ft away from the receiver, a typical system will generally work at two to three times that distance.

Many forms of optical data can be used for IR communications, but some consume more transmitter power or are more susceptible to noise than others and therefore are less desirable. Some of the simpler IR remote controls use a pulse optical format with no carrier. This system is not immune to noise because some lamps and electronic devices produce similar pulses that can cause false receptions or interfere with transmission.

A modulated carrier is less prone to interference because the receiver can incorporate filtering to effectively reject signals that are outside the frequency and duration range of a valid signal. Amplitude modulation, where the carrier is digitally (100%) modulated by the data bits, is the best choice for battery operation and low total cost. Other types of modulations consume too much power or require complex transmitters and receivers.

Generally, the upper carrier-frequency limit is governed by the response times of the IR LED, photodetector, and amplifier, and the lower limit by the data rate and power-consumption requirements. Carrier frequencies of roughly 40 kHz are commonly used.

Unlimited data forms

Though the carrier frequency range may have definite limits, the optical data form can vary widely from design to design. A limitless number of data-bit formats, codes, and error-checking methods can be employed, including standard asynchronous serial, biphase, redundancy, and various proprietary formats.

In the more expensive remote controls, a carrier is often modulated with a highly redundant IR data stream consisting of up to 20 data and error-checking bits. The redundancy guarantees Go or No-Go reception at the cost of a dramatic increase in transmission power consumption and transmission time. This technique works well for remote controls, because few commands are sent to the receiver.

A computer keyboard, on the other hand, operates at a far faster rate and for a much longer period of time than a remote control. Accordingly, redundant transmission schemes have given way to the use of audible error signals; ultrasensitive receivers; high-power, low duty-cycle transmitters used at close range; and hardware noise rejection based on long time-constant signal filtering, such as biphase, to eliminate false receptions and data formats amenable to error-detection algorithms.

The circuitry required for an infrared wireless keyboard (Fig. 2) is similar to that of an ordinary keyboard except for the additional batteries, IR transmitter, and circuitry to supply power when a key is pressed. Infrared keyboards are available off the shelf for those system designers who don't want to design their own. Typical of such units is the KXN3-8451 IR keyboard from Cherry Electrical Products Corp.

The battery-operated keyboard includes 84 full-size keys and uses the enhanced IBM PC key layout with the Shift and Return keys in convenient industry-standard positions, plus an additional Return key near the numeric keypad. The keyboard's batteries and IR transmitter are disabled when 4 to 6 V is supplied from the cable.

In wireless operation, 4 AA batteries power the keyboard's low-power CMOS circuitry. The unit turns on when a key is pressed, processes the keystroke, transmits the key code, and turns off when the key is released. With this technique, millions of keystrokes can be transmitted with one set of batteries. In wired operation, using the fully detachable cable supplied with the unit, the keyboard typically draws 5 mA, compared with 250 mA for a typical wired-only computer keyboard.

IR keyboard specifications

Infrared LEDs in the wireless keyboard allow communication over a 20-ft distance. IR LEDs produce a high instantaneous power output over a half-power angle of nearly 60°, so IR keyboards can be easily operated over this angle. Even though some usable energy is radiated over 180°, it is usually cut off by the keyboard housing or is usable only for short distances because of its relatively low power. The transmitted signal's duty cycle must be kept very low to keep the LED's average power dissipation within its limits and minimize battery drain.

Within certain limits, the energy radiated per transmitted bit rather than the signal's peak power determines a signal's receivability. For example, doubling the carrier cycles per transmitted bit and halving the output power will keep the total transmission power the same but will improve the received signal's reliability. The received carrier signal will be present for a longer time period per bit, and the receiver can significantly improve its noise filtering to reject sporadic noise impulses.

Several different data formats are used for IR computer keyboards. One is the IBM PCjr format, where the data is biphase-encoded, with each bit lasting 440 µs for a data rate of 2,273 bits per second (Fig. 3a). The IR transmission modifies this biphase encoding to produce three pulses (1½ cycles) of a 40-kHz carrier at 220-, 440- or 660-µs intervals (Fig. 3b).

Another format is used by Cherry Electric and is compatible with its IR receiver. Here the cable data format and data rate are the same as for the PCjr, but the IR format is different: biphase data directly modulates the amplitude of the 40-kHz carrier, giving nine pulses per bit, not three (Fig. 3c).

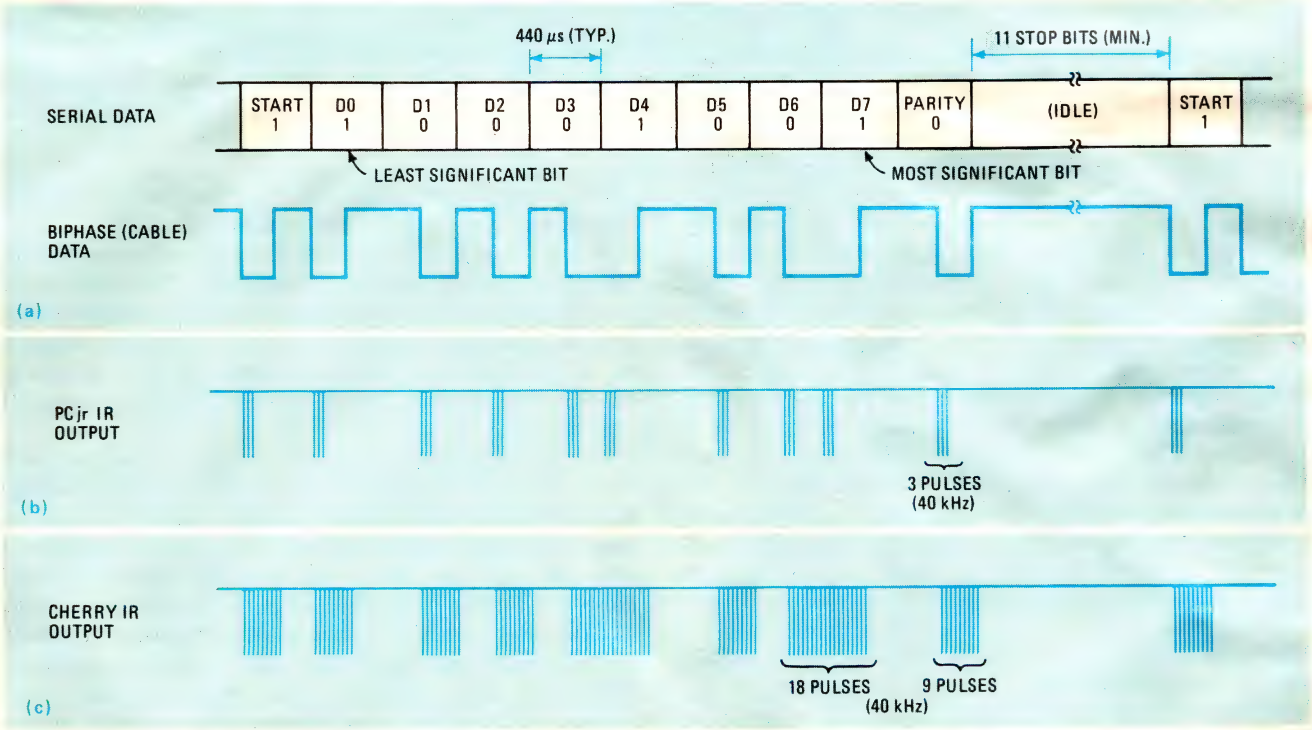
Regardless of which optical-modulation scheme is used, the carrier's duty cycle should be fixed at 50% to allow maximum turn-on and turn-off times for the LED and to allow the photodetector the maximum time to respond to the optical pulse.

Intelligent receiver

The receiver is much more complex than the transmitter, as it combines both digital and analog circuitry to convert a weak IR signal into logic signals compatible with a host computer. With an on-board microprocessor, the receiver is an intelligent peripheral, reducing the host's workload and easily modified for custom requirements. Like keyboards, receivers are available off the shelf as both printed-circuit board subassemblies and housed, finished units.

The pc-board assembly can be mounted inside the computer cabinet along with such modules as the disk drive and display unit. With this approach, the system designer does not have to redesign the main computer's pc board to incorporate the IR receiver circuitry, shielding, and data connections. Instead, a simple, short cable connects the IR receiver module to an existing communications port and 5-V power source.

One such unit is Cherry's 0B99-13AL, which allows an



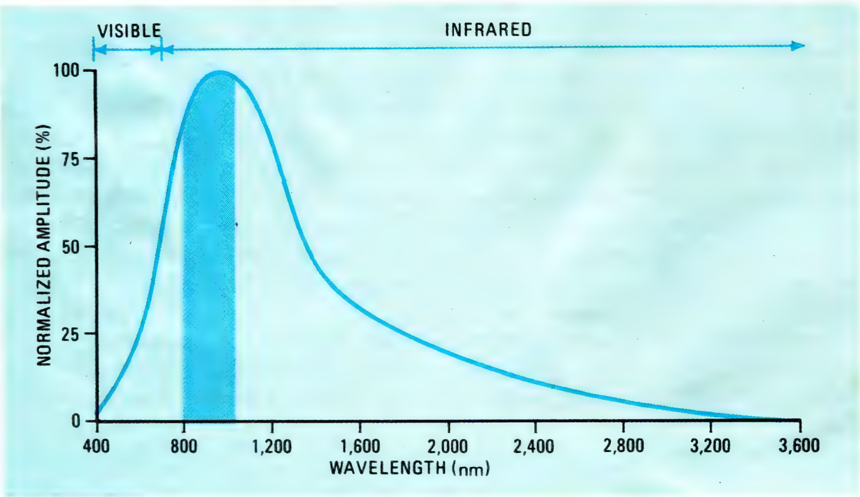
3. Data formats. In IBM Corp.'s PCjr data format for its infrared keyboard, cable data is first biphase encoded (a) and then modified by IR transmission to produce three pulses per bit (b). Cherry Electric's data format produces nine pulses per bit (c).

IR keyboard to interface to the IBM PC in both the cable and IR transmission modes. The receiver plugs into the host's keyboard socket in place of the existing keyboard, and it draws the same amount of current—typically 250 mA.

IR keyboard cables can plug into the back of the receiver to disable the IR mode and allow the host computer to supply power. The receiver includes a switch underneath that can reduce the IR reception range from over 20 feet to under 5 feet. This allows multiunit operation in the same room or cancellation of any severe optical interference that may be present.

The receiver's amplifier and time-constant circuits filter the IR signal, suppressing noise above and below the carrier frequency. The receiver's biphase decoding software tolerates instantaneous and long-term speed variations of over 15% from the nominal 2,273 b/s, and many error checks are performed as transmitted bits are received. The receiver checks the IR and cable transmissions on a bit-by-bit basis.

First, each bit's duration is measured to check transmission speed. Unless the speed is out of range by one or more bits, the speed can vary widely within a given transmitted word and the word will still be received correctly. Next, checks are made to detect any change in the standard biphase serial transmission pattern. Finally, the parity of the received word must be correct. If any error is detected, the receiver will transmit an error code of FF hexadecimal to the host computer. This causes the computer to beep, audibly signaling the error to the user. The result is a data link that is almost impossible to trick.



4. Fluorescent-lamp culprit. A fluorescent lamp operating in a mercury-vapor environment produces a series of sharp pulses high in harmonic content, which can trigger sensitive frequency-selective circuits in infrared receivers.

The receiver retransmits the incoming data to the host computer at 96 kb/s using both the standard asynchronous serial (UART) format and the IBM Corp. Personal Computer synchronous clock and data serial format. In the IBM PC format, one start bit (logic one) and then eight true data bits are presented on the data line, each accompanied by a pulse on the clock line. In the asynchronous format, a start bit (logic zero) is followed by eight true data bits and one stop bit (logic one). The line levels are TTL-compatible.

Both methods offer advantages. With the asynchronous approach, a standard UART can be used. With the synchronous approach, a simple shift register converts the serial data into parallel. It also permits a 32-level first-in/first-out buffer in the receiver to store incoming codes until the host computer can accept them. The host computer can inhibit further transmissions by pulling the data line low after a word has been clocked in.

Pulling the clock line low for longer than 5 ms initiates a reset request. This causes the receiver to reinitialize all software activities and clears the FIFO buffer. This feature can be used with both synchronous and asynchronous interfaces.

The receiver housing incorporates an optical filter to attenuate visible light and pass IR wavelengths. The filter appears opaque black to the eye and not only hides the receiver circuitry for aesthetic purposes but attenuates visible light interference. A silicon photodetector's response usually ranges from the far infrared to the near ultraviolet and is susceptible to the modulations of ambient visible light. The cutoff characteristics of the IR-transparent filter allows the visible ambient light to be rejected without attenuating the signal.

The optical reception angle of commonly used photodetectors is extremely wide, approaching 180° from the optical axis. The housing design can limit this angle with an appropriately shaped bezel in front of the detector. The horizontal viewing angle can be symmetrical horizontally about the optical axis, but the vertical viewing angle should be asymmetrical to prevent strong overhead lighting from disrupting communications while still allowing signals below the optical horizon to enter the detector. Thus a user can beam a signal up into the receiver while sitting below the receiver's level. The result is that the receiver can be placed in almost any convenient spot within view of the keyboard.

Several types of photodetectors are available, but not all are suitable for use in IR receivers. Phototransistors, for example, have response-time orders of magnitude too slow to detect an optical carrier with sufficient sensitivity. Photodiodes, on the other hand, are fast enough to do the job and often include a built-in filter to attenuate visible light.

The most common type of photodiode is the p-i-n diode, which is reverse biased, with the bias voltage determining its capacitance; voltages above 10 volts are required for adequate response. The p-i-n diode produces little noise current but also low signal current. A low-noise, high-input-impedance amplifier is necessary to detect the faint optical signal, with gains between 40 and 80 dB required to elevate the signal available at the photodetector to a usable level for detection.

Some parts of a typical computer unit, such as the flyback transformer used in the cathode-ray tube display, cause electromagnetic interference, which may be coupled into an unshielded receiver circuit from over two feet away. The receiver's amplifier must be shielded to prevent this emi from causing interference.

It is necessary to dynamically alter the p-i-n diode's dc response to minimize the effect ambient lighting has on the received signal. This can be done with an automatic electronic sensitivity adjustment used with a dc emitter that prevents the p-i-n diode from saturating when exposed to strong IR light.

The amplifier and photodetector circuitry must deal not only with a tiny input signal but also with a severe input overload—after all, a keyboard may be expected to operate with the LED only a fraction of an inch away from the photodiode. No signal level, from zero to maximum, can cause breakup or frequency multiplication that might lead to improper demodulaton. Also, the IR signal can change in intensity rapidly if the beam is suddenly blocked. These sudden signal-level changes must be tracked or the link will be prone to dropouts.

An ideal IR amplifier would only respond to the IR carrier frequency, but this implies the use of a filter with a high quality factor (Q) to provide a narrow bandwidth. But if there are only a few carrier cycles per transmitted bit, the Q must be quite low so that the demodulator can differentiate between the signal and an optical noise pulse; a high-Q filter would cause the noise pulse's ring to exhibit almost as long a decay time as the signal, and it would be hard to tell the difference between them.

Conversely, systems using many cycles per bit can be made to reject both out-of-band signals and noise pulses with the use of a high-Q filter. For this reason, the Cherry IR format has three times as many cycles per bit as the one used by the PCjr.

Light-bulb culprit

Ambient lighting can cause saturation of the photodetector but poses a far greater threat when modulated at a rate that will be picked up by the receiver. This interference can cause false reception if a lamp is too close to the receiver or if sunlight falls on the photodiode. Less intense light will reduce the reception range since the transmitter must overpower the noise source. Still less intense light will not have much impact on the receiver, but still can cause a comparatively large dc photodiode current to flow.

An incandescent filament can cause high frequency-modulated optical noise much more effectively when immersed in certain gases. The steeply rising optical pulses by fluorescent bulbs are rich in high-frequency harmonics that easily resonate frequency-selective circuits in IR amplifiers.

The average fluorescent lamp's IR energy level is very low (Fig. 4) so the photodetector's current won't be high enough to invoke the dc limiter; both detector and amplifier then operate at maximum sensitivity and faithfully present these noise signals to the demodulator stage.

On the positive side, it is likely that fluorescent lamps in the vicinity will be many feet away or won't be visible from the receiver. So only faulty, flickering fluorescent lamps or ones being turned on will usually cause problems. Obviously, any kind of lamp placed only a few feet away should be moved if it shines directly into the receiver, regardless of how noise-immune the receiver is.

Display devices such as multiplexed alphanumeric readouts and other strobed light sources are also potential sources of IR optical noise. In most cases they will not cause problems because both they and the receiver face outward from the cabinet toward the user.

Probably the most obvious source of optical noise is another IR transmitter, either of the same type as the first transmitter or totally different. The use of another IR communications link in the vicinity will almost certainly cause problems: either it will produce false data outputs from the receiver, or it will have no effect until two transmissions clash, garbling data.

Interference solutions

There are several ways to thwart interference, but most of them can be used only during the optical link's design stage. First, a study can be made to determine the characteristics of the offending IR devices, including modulated carrier frequency, signal strength, optical wavelength, transmitter beam divergence, and number of carrier cycles per data bit. Then the IR link can be designed so that it will reject the undesired signals.

The most common solution is to pick a carrier frequency significantly different from offending signals so a narrow bandwidth filter will reject all but the strongest of the undesired signals. Unless the offending transmitter is quite close, its signal strength will be quite low and will not be sensed. However, this voids the use of IR transmitters using only a few carrier cycles per bit.

The solution is more difficult when multiple, identical keyboard-receiver pairs are to be operated in the same room (which should be avoided since there are only a few options available). First, each keyboard and receiver may require a switch to change its carrier frequency, but this technique is impractical for more than four frequencies and isn't cost effective. It requires a keyboard that can generate multiple, precise frequencies and a receiver with individually tuned high-Q filters. Also, upon installing the link, the user must make sure that both the keyboard and the receiver are tuned to a unique carrier frequency; this involves looking at every link in the room to determine which frequency (if any) is open.

Second, each unit may have a narrow transmit and/or receive angle to prevent the signal from being picked up by neighboring units. This approach is unattractive because it almost guarantees some missed keystrokes if the keyboard is poorly aimed. And a strong neighboring signal can easily reflect off objects near the receiver and be detected. Third, the receiver's sensitivity can be reduced to prevent neighboring but more distant keyboards from being sensed.

This approach is used in the Cherry receiver because it is practical and cost effective; most computer users will be closer to their own computer than to their neighbor's. And severe optical noise sources will have much less effect on the receiver. The penalty, however, is that the user must be a bit more careful in aiming the keyboard at the receiver and must not get too far away from it since distance reduces signal strength. ☐

Brent La Reau is an electrical application engineer at Cherry Electrical Products Corp., Waukegan, Ill., and is involved in the development of input/output devices.

NEW PRODUCTS

GENERATOR PUTS OUT 1-GHz SIGNALS

Portable instrument checks both AM and FM radio gear with resolution to within 1 dB, stores 100 settings in memory ☐ *by Steve Zollo*

Priced at just $3,950, the 2022 synthesized signal generator fills in the Marconi Instruments line on the low end but offers the features of competitive high-end instruments. According to Marconi, the use of innovative design and production techniques has enabled it to surpass previous price-performance levels with the 2022, an instrument designed for a range of general-purpose applications, including servicing and maintenance.

The lightweight (16½ lb), portable instrument covers the carrier frequency range of 10 kHz to 1 GHz, including all radio-communications bands from very low frequency (for naval applications) to ultra-high frequency (for high-performance mobile applications) and embracing all intermediate frequency ranges. For signals up to 100 MHz, frequency resolution is said to be 10 Hz, allowing narrowband single-sideband equipment to be tested.

"The launch of the 2022 represents a major breakthrough," says Keith Elkins, Marconi's U.S.-based marketing manager. "Not just because of its incredible price-performance level but also because of the way it brings all the latest productivity-boosting instrument features to a very broad base of users in the lower-cost market areas."

Comprehensive amplitude, frequency, and phase modulation facilities enable the 2022 to support the testing of practically all types of radio equipment; the phase modulation permits measurements to be made on FM receivers fitted with de-emphasis circuitry as used in mobile radio applications. Digital signals now commonly used in FM radio systems can also be accommodated through the external-modulation input.

In addition, output-level accuracies are typically held to within 1 dB, allowing accurate testing of modern radios over their full operating range. An offset facility lets the user make adjustments in 0.1-dB steps.

With push-button entry of all instrument settings (carrier frequency, modulation, and output levels), the microprocessor-controlled keyboard allows single-key incrementing of all parameters in user-defined step sizes. This simplifies manual measurements of bandwidth, sensitivity, and modulation linearity. For faster routine measurements, up to 100 instrument settings can be stored in the setup's nonvolatile memory. An optional General Purpose Interface Bus (IEEE-488), which provides full talker and listener capabilities and permits all front-panel functions to be programmable, is available for $195.

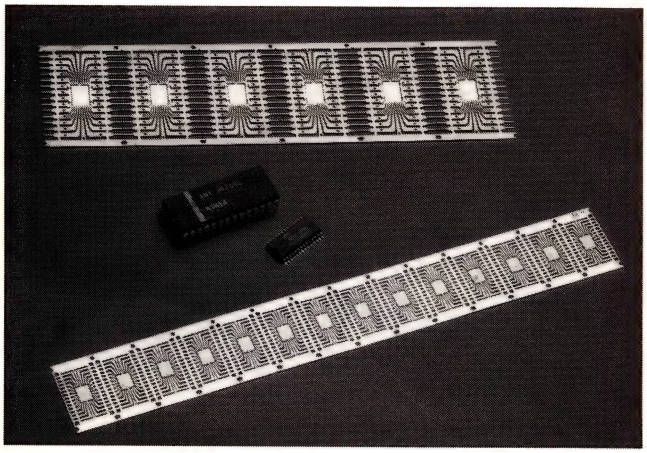
Simultaneous readout of carrier frequency, modulation, and rf level is provided on the instrument's liquid-crystal display panel; the units for level, dBm, or microvolts are selectable by the user. Operating messages such as "out of limits" are also incorporated into the display.

In addition to the 2022, Marconi is introducing the 2018A and 2019A signal generators, enhanced versions of the 2018 and 2019, respectively. The 2022, which was first shown in the U.S. at Wescon and in Europe at Electronica, is available now.

Marconi Instruments, 3 Pearl Ct., Allendale, N.J. 07401.
Phone (201) 934-9050 [Circle reader service number 338]

Board density is upped by small-outline IC package

A small-outline package for integrated circuits adheres to standards for the 0.3-in. wide-body package set by the Joint Electron Device Engineering Council and almost doubles the number of chips that can be placed on a printed-circuit board, according to the manufacturer. Called the smallest dual in-line package available, the SOIC can be surface-mounted automatically on pc boards by pick-and-place equipment. Suggested applications include the automotive, communications, and computer-manufacturing industries.



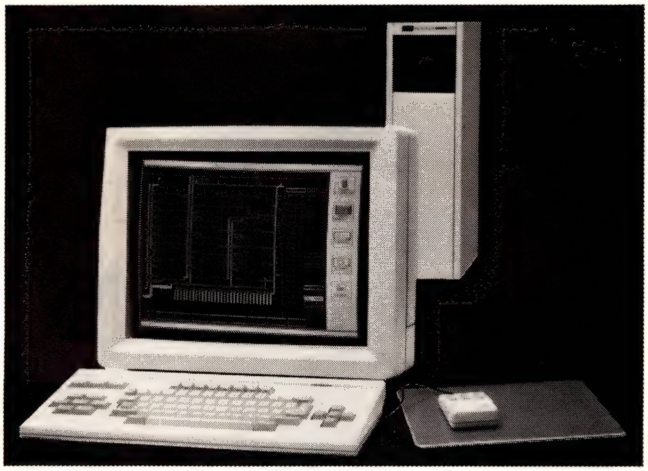
Available in 16- and 28-lead packages, the 28-pin SOIC measures 0.419 in. wide (maximum), including the gull-wing leads, and 0.712 in. long (maximum). The leads are positioned 50 mils apart and are made of 0.010-in.-thick copper, said by the manufacturer to be the material most resistant to bending or other damage during placement.

The SOIC is available now for standard products as well as for custom and semicustom designs. Automatic test capability will be in place in the fourth quarter of 1984. No price was available at press time.

Gould AMI Semiconductors, 3800 Homestead Rd., Santa Clara, Calif. 95051. Phone (408) 554-2041 [Circle 342]

Variations on work station give board-design options

Three computer-aided design work stations for printed-circuit-board design have been developed out of the manufacturer's earlier CDX-5000. The CDX-5000A offers users a price break with all the functionality of the CDX-5000 and the same 32-bit internal architecture, the manufacturer says. The CDX-5000A has 1.5 megabytes of internal memory, expandable to 3 megabytes, and a virtual-memory operating system in software. Placement and routing of pc boards is automatic.



The CDX-50000, the high-performance offering, adds a graphics-accelerator engine based on a bit-slice processor with an 88-bit microcode word that makes possible a typical rate of up to 400,000 clips-and-transforms/s in a 120-ns cycle time. Software includes a hierarchical schematic editor, and memory is 2 dual-port megabytes, expandable to 3 megabytes.

Called a complete solution to electronics systems design, the CDX-59000 adds powerful software to the CDX-5000 work station. Features include the Cadat 12-state logic simulator, a Scald-based timing analyzer, a technical publications package, and a graphic waveform editor. Postprocessing with open-file architecture is provided, along with Berkeley 4.2 Unix and a C compiler.

Ethernet is available as an option on all the manufacturer's work stations. Both the CDX-50000 and the CDX-59000 are recommended for very large boards holding up to 700 integrated circuits.

The CDX-5000A, priced at $49,900, is available with 30-day delivery. A single CDX-50000 work station carries a tag of $79,900, and delivery is in 60 days. Price of the CDX-59000 is $94,900, and it will become available in December. Delivery is in 60 days.

Cadnetix Corp., 5757 Central Ave., Boulder, Colo. 80301.
Phone (303) 444-8075 [Circle 353]

CADD software is joined to the IBM PC AT computer

A two-dimensional drafting system with 32-color resolution and a menu-driven data base, the Anvil-1000MD computer-aided design and drafting software, is offered for IBM Corp.'s Personal Computer AT and its professional graphics controller and display.

The Anvil-1000MD includes a full range of construction algorithms, an implicit-points capability, true dimensioning, annotation capabilities, and more. Built-in curve

fonts are user-defined, and the system automatically converts units of measure when drawings and standard components are merged. A levels feature separates drawings into up to 1,024 levels, allowing iteration with all parts of a drawing on one or more levels simultaneously.

The basic configuration of the Anvil-1000MD CADD system includes the PC AT with 512-K bytes of memory and a 20-megabyte hard disk, a 128-K-byte memory expansion card, IBM's professional graphics controller and professional color graphics display, an 80287 math coprocessor, an IBM six-pen color plotter, a joystick, ports, and connectors. The operating system is PC-DOS 3.0, and the Anvil-1000MD software is supplied on three disks with documentation.

This minimum configuration is priced at $15,885. The system will be available in December 1984.

Manufacturing and Consulting Services Inc., 9500 Toledo Way, Irvine, Calif. 92718. Phone (714) 951-8858 [Circle 354]

Office systems network links software from DG, DEC

Soon, TransNet will be supporting Data General Corp.'s CEO office system and Digital Equipment Corp.'s All-in-One office systems, in addition to its earlier joining of systems from IBM Corp., Wang Laboratories Inc., and Xerox Corp. TransNet, when installed on an IBM mainframe or a look-alike, permits incompatible office systems from these vendors to exchange text documents, which can then be edited by any of these systems, whether sending or receiving.

Under TransNet, multiple-vendor office systems can communicate through the mainframe host's IBM Systems Network Architecture Distribution Services. The communication is accomplished through mainframe data streams known as Document Interchange Architecture and Document Content Architecture.

The network is a compatible enhancement of IBM's Disoss, the medium through which IBM's incompatible office systems are allowed to communicate using the mainframe host. TransNet is modular, so that individual features can be added as needed.

TransNet's base price is $35,000, and additional features are priced from $2,000 to $35,000 each. The manufacturer installs and supports the product. The options supporting Data General and DEC systems will be available in 1985. Exact prices have not been set.

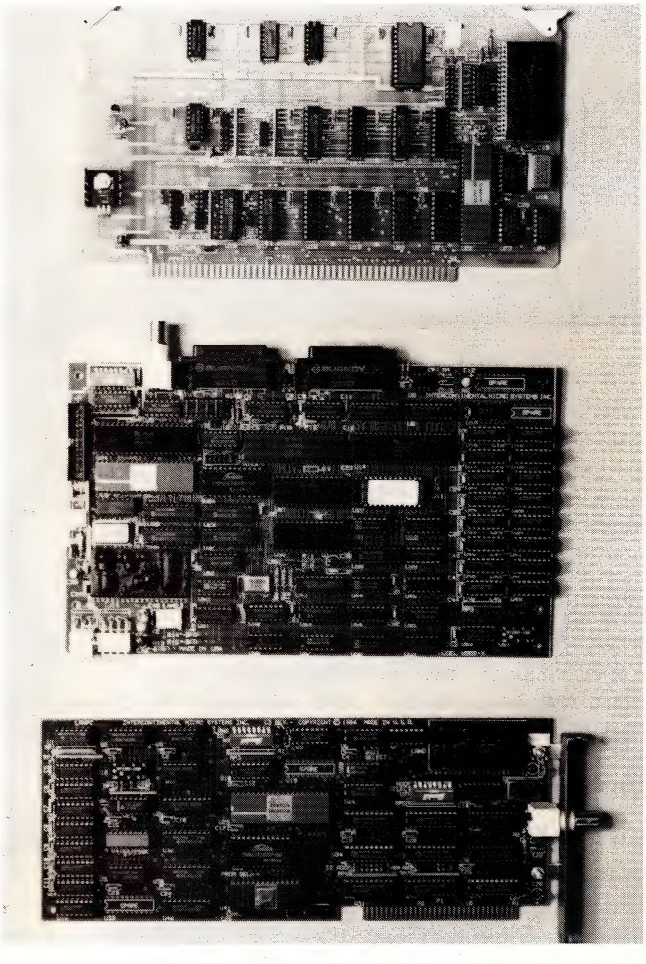
Network Applications Inc., 9020 Capital of Texas Hwy. N., Suite 100, Austin, Texas 78759. Phone (512) 474-2084 [Circle 352]

Network hardware line offers three system combinations

A product line allows systems integrators to build multiuser Arcnet-based networks in three combinations. It includes LanS100, an S100-bus local-area-network controller card; the WS80 processor board, which converts dumb terminals into 8-bit intelligent work stations with on-board LAN capability; and the LanPC controller card, which allows the integration of IBM Corp. Personal Computers and their look-alikes into the manufacturer's network.

With these three products, the systems integrator can build with any combination of the following: S-100 bus structured networks, 8-bit individual work stations, and IBM PC-compatible computers.

The hardware line is based on the Arcnet protocol. The manufacturer also announces MicroNet, the networking system that allows linking of the hardware line.



MicroNet is based on Software 2000's Turbodos, which is fully compatible with Digital Research Inc.'s versions of CP/M, allowing use of a wide range of CP/M-compatible languages and applications software packages.

The LanS100 is priced at $495, the 6-MHz model of the WS80 processor board at $1,045, the LanPC controller card at $650, and the MicroNet driver at $250. All are currently available.

Intercontinental Micro Systems Corp., 4015 Leaverton Ct., Anaheim, Calif. 92807. Phone (714) 630-0964 [Circle 351]

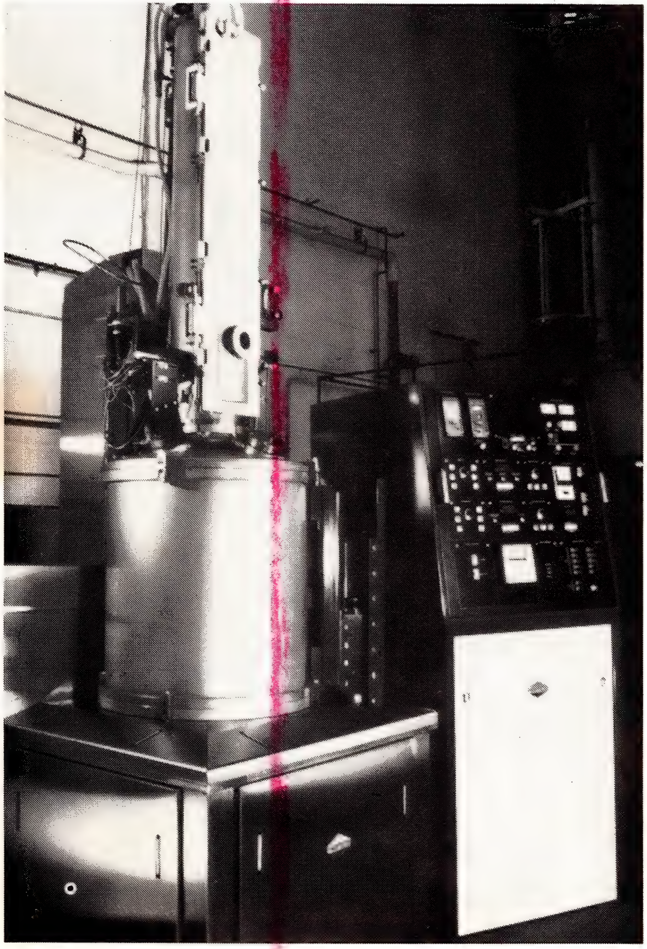
Furnace grows 8-in. crystals within 14-to-18-in. hot zone

Available with a hot zone of 14, 16, or 18 in., the CG 6000 crystal grower can produce crystals that are 8 in. in diameter, with a capacity that goes up to 60 kg. The CG 6000 can be ordered with automatic controls for precise monitoring and control of the entire crystal growth cycle.

The manufacturer's product line, in addition to crystal-growing furnaces, includes annular saws and polishing-lapping machines that produce 8-in. wafers for all semiconductor, optical, and photovoltaic uses.

Delivery of the CG 6000 will be made in 16 weeks. The manufacturer will quote prices on request.

Kayex Corp., 1000 Millstead Way, Rochester, N.Y. 14624. Phone (716) 235-2524 [Circle 349]



Disk industry is offered robot sputtering system

Sputtering equipment for hard-disk manufacturing systems is automated through the VS-100, which loads and unloads disks in a vertical-pallet sputtering process. At this time, the VS-100 operates with the ZV-1200 vertical sputtering system from Leybold-Heraeus Technologies and with the V-2000 from Circuits Processing Apparatus. The VS-100 can be made available for other, similar systems on request.

The VS-100 meets the standards for a Class 100 clean room. It has self-diagnostic capabilities, and in case of an operator error, the system will detect the error and take appropriate action so that the manufacturing process does not stop. The cycle time is 7 s.

Standard features include a disk gripper that handles disks and cassettes (and pallets for the V-2000), dual-gripper design, real-time production-data collection, data integrity in case of a power failure, and an intelligent operator pod that includes a display terminal and six operator push buttons. Operator-protection interlocks exist in the robot's workspace.

Options include a conveyor, a host-computer data link, a printer, and voice communication to the operator. A single-gripper model is also available, as well as various cassettes.

The price for the VS-100 dual-gripper robot with an input and output station ranges from $310,000 to $390,000. A single-gripper robot and one station for loading and unloading sells for between $150,000 and $180,000. Volume discounts are available; prices include installation and operator training. Delivery time is approximately four to five months.

Phase 2 Automation, 3460 W. Bayshore Rd., Palo Alto, Calif. 94303. Phone (415) 493-5740 [Circle 350]

Optical memory system records variety of media

The first commercially available optical recording and reproducing system, the OMS-1000, is designed as a research tool that can evaluate various magneto-optical recording media, including Direct Read After Write and erasable disks.

Even though the OMS-1000 is designed to be a general-purpose research tool, it contains a built-in compact-disk formatter, an 8-to-14-ratio modem, and precision 16-bit analog-to-digital and digital-to-analog converters. The OMS-1000's built-in analog circuitry and recording-level meters allow the system to be used for audio recording.

As a magneto-optical disk evaluator, the OMS-1000 is capable of measuring the raw error rate of the medium and, through the compact-disk formatter, the carrier-to-noise ratio. Error rate is displayed as the number of 1-byte errors in 10,000, 20,000, or 40,000 frames, depending on the mode chosen.

The laser pickup can be set at one of three numerical apertures—0.5, 0.55, or 0.6. It can record and reproduce

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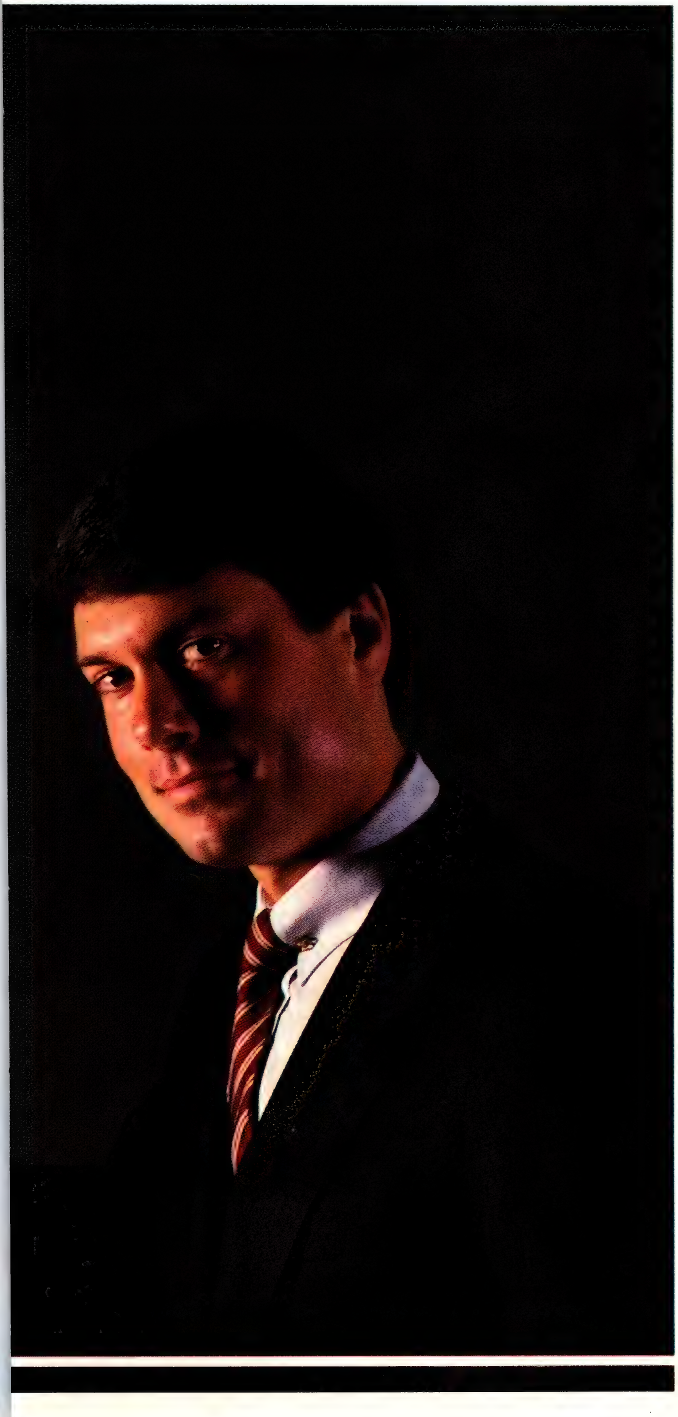

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The S83 OS Processor contains the basic control, address and data signals and instructions of the Z80. That makes it compatible with all Z80 peripheral support circuits. The chip connects directly to 64K DRAMs. And the internal ROM can be software disabled to access external memory.

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All from OKI Semiconductor, the major IC supplier uniquely qualified to respond to small-box maker demands in both areas—as a world leader in low-power, battery-backup VLSI components, whose product innovators can draw upon a 105-year history in the research, development and mass production of successful telecommunication electronics.

From a position of strength, OKI can offer the small-system designer not only all the CMOS devices required for total low-power system integration, in order to improve portability, compactness and cost-efficiency. We can also help you tie in those critical telecomm functions through our CMOS single-chip modems and VLSI communication products. With the same systemwide concern for ease of use, development support and volume availability which has accompanied every big OKI CMOS move:

Software-compatible CMOS 4, 8 and 16 bit microprocessors, CMOS 4 and 8 bit MCUs. Pacesetting CMOS high-density memories and CMOS gate arrays. Extending this commitment throughout your system to include CMOS speech chips, real-time clock, and a full range of peripheral products.

Now we're opening up to world markets OKI's long-established communications capabilities, combined with our CMOS know-how, to give you a double-edged tool against your competition.

OKI TELECOMM CMOS MODEMS

SPEED	APPLICATION	PART NUMBER	AVAILABILITY
300 Baud	Bell 103, FDX CCITT V.21, FDX	MSM6946 MSM6926	Now Now
1200 Baud	Bell 202, HDX CCITT V.23, HDX	MSM6947 MSM6927	Now Now
300/1200 Baud Auto-Switch	Bell 212A, FDX	Hybrids Chip Sets	4Q84 1985
2400, 4800, 9600 Baud	Application-specific high-speed data exchanges	Modem Boards Chip Sets	Now TBA

The OKI CMOS edge: line access through line-powered modems . . .

OKI brings uncommon design ease and flexibility to your common standard modem applications through the special advantages offered by our advanced CMOS VLSI processes:

Telephone line-access with lower line-power requirements. Battery backup for higher reliability. And the small single-chip modem saves significant board space—it's so compact you can now integrate the modem function into your system itself at a very low cost.

The Bell-compatible 6946/6947 and the CCITT-compatible 6926/6927 modem ICs will transmit and receive serial, binary data over the switched telephone network using FSK modulation. With a much lower bit error rate than similar devices on the market. The signal to noise ratio is only 7 dB, with a bit error rate of 1×10^{-6}.

To simplify design-ins, OKI has put on-board these single-chip devices all the modulation, demodulation and filtering functions required to implement a serial, asynchronous communication link—with no special telecomm experience or expertise necessary.

On-chip: CMOS analog and digital signal processing; selectable built-in delay timers and an external delay-timing capability; plus originate and answer modes (at 300 baud). Application ease is internally reinforced by an integral crystal oscillator, and a TTL-compatible digital interface. OKI's single-chip modem design assures compatibility with a broad installed base of low speed modems and acoustic couplers; the OKI CMOS edge assures you of an easy-to-use low-cost alternative to the less-efficient standard discrete modem approach.

Plus expanding telecomm support

OKI's on the move in low-power communication products, with still more OKI CMOS solutions for your small-system telecomm needs.

CODEC

MSM6910	CMOS Codec/Filter Combo
MSM6912	CMOS PCM Audio Filter
MSM6932	CMOS Codec, u-Law (USA), with Filter
MSM6933	CMOS Codec, a-Law (Europe), with Filter
MSM6913	Parallel to Serial/Serial to Parallel
MSM6914	Space Switch
MSM6917	M-255 Companding Codec
OCS30/31	Hi Voltage Cross Point Switch

Dialers

MSM6224	CMOS DTMF, Keyboard
MSM6234	CMOS DTMF, Keyboard or Up
MSM5249	CMOS Pulse Dialer
MSM6052	Pulse/Tone Dialer

DTMF Decoder

MSM6920	Digital PABX (1/85)
MSM6945	END to END (12/85)

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( ) OKI CMOS Modem chips, CCITT data sets
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( ) Other OKI modem/telecomm requirement: ____________

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OKI Semiconductor, 650 North Mary Avenue, Sunnyvale, CA 94086
Tel: **(408) 720-1900.** (Please note new address and phone.)

OKI-71-984

Circle 83 on reader service card

TRACK DOWN STATIC FAST.

Before you spend any more money to safeguard against static problems, it only makes sense to see how much of a problem you have. That's why every static-prone environment should have an ACL 300 electrostatic locator.

This lightweight, hand-held static detector pinpoints and measures static quickly and accurately—from zero to 30,000 volts.

The ACL 300 is battery-operated, easy to use and is made to last for years. Little wonder this portable unit has become the industry best-seller!

You can't solve a static problem until you can identify it. And nothing identifies static like the ACL 300—the perfect complement to your static control program.

on the disk anywhere between 53 and 97 mm from the center. The pickup can be preset to any point within this range, and a keypad indexes the pickup in 0.1-mm increments. Laser power can be preset in steps of 0.1 mW independently for the record, reproduce, and erase modes. Focus and tracking gain adjusts automatically to compensate for differences in disk reflectivity and groove pitch and depth.

The OMS-1000 is controlled by six 8-bit microprocessors. This, in addition to its modular design, gives it versatility under different experimental applications.

The cost of the OMS-1000 is approximately $80,000. The manufacturer is taking orders now.

Nakamichi U.S.A. Corp., 19701 S. Vermont Ave., Torrance, Calif. 90502.
Phone (213) 538-8150 [Circle 348]

Voice and data network uses a PBX's twisted pairs

An integrated voice and data information management network provides integrated local-area-network capabilities and attaches to existing private branch exchange and Centrex systems. The network carries voice and both low-speed terminal data and high-speed work-station data over existing twisted-pair telephone wiring.

The basic hardware unit rests between the host telephone system and up to 120 telephones. Additional units can be added modularly to form a large distributed network. The complete system also includes a 2-Mb/s transmission protocol, gateways to connect the unit to PBX or Centrex systems, and a family of adapters for LANs, terminals, and personal computers.

The information-management network ties together distributed terminals and personal computers. Personal computers with RS-232-C-compatible interfaces may be used as terminals through IBM Corp. protocol converters. At each telephone, the network makes accessible 1 Mb/s of packet-switched data.

The system supports the standard Ethernet interface, which connects personal computers from a variety of vendors. Print servers, file servers, and other shared resources may be connected to the network either as RS-232-C or Ethernet devices. Available now, an installed and maintained network starts at $1,200 per voice/data line.

David Systems Inc., 701 E. Evelyn Ave., Sunnyvale, Calif., 94086.
Phone (408) 720-8000 [Circle 360]

Multiplexers link serial lines to VAX, PDP-11

Two asynchronous multiplexers connect serial lines to the manufacturer's Unibus-based VAX and PDP-11 computers. The DHU11 multiplexer links up to 16 asynchronous terminals to any PDP-11 or VAX computer; the DMZ32 multiplexer supports up to 24 asynchronous hookups to Unibus-based VAX computers.

Both are said to address medium- to high-performance communications requirements. The DHU11 provides high serial-line density on a single hex-size circuit card. Connection with external equipment is through RS-232-C and RS-432-A interfaces. The DHU11's central processing unit also has direct memory access and retrieves data on a first-in-first-out schedule, for maximum effiency.

The DMZ32 provides interfaces for terminals to VAX systems and enables a terminal distribution panel to be located up to 5,000 ft from the multiplexer's Unibus connection in the computer system. It also has 24 RS-232-C connectors with DMA and FIFO operations.

Both controllers can provide half- and full-duplex communications. The DHU11 is priced from $3,120 and the DMZ32 from $3,215. Both are available now.

Digital Equipment Corp., Maynard, Mass., 01754. [Circle 361]

Optical bit-driver operates at up to 56,000 b/s

The Optical Bit-Driver is said to provide environmental integrity during short-haul or longer-haul data transmission. Model 2000 units are available as asynchronous or synchronous, simplex or full-duplex op-

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When you buy the ACL 300 static locator, you'll soon see how it can become a valuable addition to your quality control system.

And speaking of values, for a limited time only, you'll receive this handsome cowhide carrying case with metal clip (a $16.50 value) FREE. Just buy the battery operated ACL meter now, and the case is yours!

Why wait? Take advantage of this special offer. The ACL 300 will locate static problems—saving you time, frustration and guesswork—and you'll get a free bonus if you buy now. We rest our case.

ACL MODEL 300
ELECTROSTATIC LOCATOR

ACL Incorporated
1960 E. Devon Avenue
Department 102
Elk Grove Village, IL. 60007
(312) 981-9212 Ext. 102

Circle 85 on reader service card

Offer expires Dec. 31, 1984

tical systems. The units are designed for in-house process control or in-plant interconnection of electronic data-processing equipment for operation of up to 56,000 b/s over distances of between 2 and 10 km. System operating temperatures range from 0°C to 70°C. Fiber-optic cable makes the systems immune to electromagnetic interference and radio-frequency radiation in areas with high levels of electrical noise.

The stand-alone units include an RS-232-C interface, a 120-V-line power cord, and input/output transmission connections. Two fiber-optic connector receptacles interface with fiber-optic duplex cable. Status light-emitting diodes indicate the presence of a carrier and data signaling over the communications path.

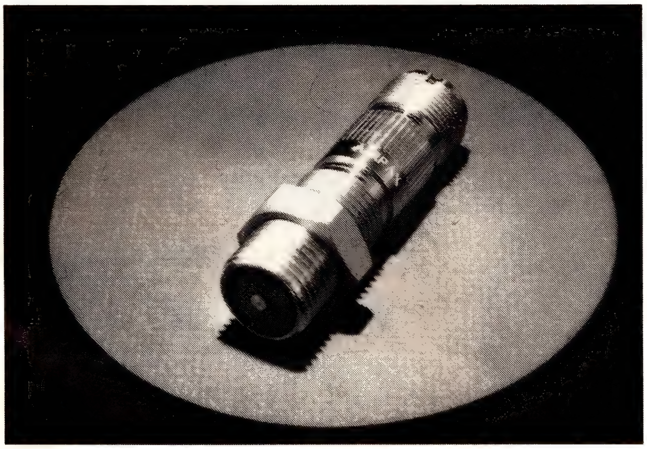
The asynchronous model with plastic case lists for $190; with metal case, $245. The synchronous model with metal case sells for $275. All are available now.

S.I. Tech Inc., P.O. Box 609, Geneva, Ill. 60134.
Phone (312) 953-2300 [Circle 362]

Speed sensor reduces magnetic drag by 50%

Through improved design, the model 8-0016 magnetic-speed sensor produces the same output as other sensors with a field strength of less than 450 gauss—a 50% improvement over the usual field strength, according to the manufacturer. When used with small, lightweight targets such as turbine flowmeters, the 8-0016 is said to improve the low-speed behavior of the target and allow linear measurements over a broad range of speeds.

Under standard test conditions using a 20-pitch, 30-tooth gear with a 0.005-in. gap at a 100-kΩ load and a surface speed of 1,000 in./s, the unit produces an output of 95 V peak-to-peak minimum. The operating and storage temperature of the 8-0016 is from –40°F to +200°F.



Evaluation units are available from stock; production orders are available in six to eight weeks. The unit is priced under $14 in quantities over 1,000 pieces.

Airpax Corp., 6801 W. Sunrise Blvd., Fort Lauderdale, Fla. 33313.
Phone (305) 587-1100 [Circle 345]

Three bipolar macro arrays interface to ECL, TTL

Designed to interface simultaneously with external emitter-coupled logic and TTL, the V1200, V1700, and V3500 are bipolar macro arrays fabricated in an oxide-isolated, two-level metal process that provides equivalent internal gate delays of 800 ps at 1 mW per gate. The V1200 has 1,338 maximum equivalent gates, the V1700 has 1,712, and the V3500 has 3,632.

The arrays are supported by an extensive library of physical macros that are equivalent to Motorola Inc. and other macro libraries. One, two, or four adjacent primary-logic cells can be used for physical macro placement without using any routing channels.

The universal input/output cells on the periphery of the arrays perform all buffering and drive functions, in addition to TTL-to-ECL-level translation for external interfacing to both ECL and TTL circuitry. The arrays are available in a variety of packages including pin-grid arrays, leadless ceramic chip carriers, and ceramic dual in-line packages.

Designs are now being accepted for the V1200 and V1700 arrays, and the V3500 will be available for custom design during the second quarter of 1985. Prices vary according to the customer's requirements.

Vatic Systems Inc., 761 University St., Mesa, Ariz. 85203.
Phone (602) 962-8998 [Circle 340]

Four-digit decoder/drivers decode into hex or decimal

Two versions of CMOS four-digit liquid-crystal-display decoder/drivers are recommended for applications such as digital meters, calculators, automobile dashboards, and appliance-control panels. They are nonmultiplexed.

Both versions are available in two operating modes. The CD22104 and CD22105 decode binary inputs into hexadecimal outputs. The CD22104A and CD22105A convert binary inputs to decimal outputs.

The circuits differ in how the digit-select inputs activate each LCD in a display. The CD22105 and CD22105A permit simple interfacing with a microprocessor; they employ a two-bit select-code latch under the control of two chip-select inputs for selecting the digits. In the CD22104 and CD22104A, four digit-select inputs go directly to latches that control each digit.

Both versions are identical in producing four sets of seven-segment LCD-driver signals and a backplane driver signal, which is derived from an on-chip free-running

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Circle 109 on reader service card

oscillator. The backplane signal is common to all four-digit displays.

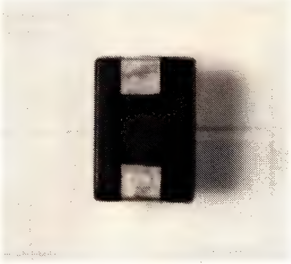
Both versions are supplied in a 40-lead, dual in-line plastic package and operate over a temperature range of –20°C to +70°C. The typical power supply is 5 V, but both versions can run from supply voltages up to 6 V.

In quantities of 100 pieces, the CD22104/104A and CD22105/105A are priced at $5.95 each. Delivery is in eight weeks.

RCA, Solid State Division, Rte. 202, Somerville, N.J. 08876.
Phone (800) 526-2177, ext. 7415.

Film-chip capacitor has stacked film construction

A metalized film-chip capacitor called the MKT 1824 is molded in a flame-retardant plastic case (UL 94 VO) and comes in three sizes: 0.01 to 0.22 μF, with a maximum length of 7.5 mm, and 0.01 to 0.15 μF, with a maximum length of either 5.7 mm or 4.2 mm.



The polyester-chip capacitor has a rated voltage of 63 V dc, high resonance frequency, and low impedance. Its small dimensions are the result of its stacked metalization film construction.

The MKT 1824 is also suitable for wave soldering up to 5 s at 260°C (240°C/5 s for the MKT 1824 M). It is also suitable for reflow soldering up to 10 s at 260°C and for automatic surface mounting.

Samples are available now. Prices and delivery information are available on request from the manufacturer.

Roederstein Electronics Inc., P.O. Box 5588, 2100 W. Front St., Statesville, N.C. 28677. Phone (704) 872-8101 [Circle 356]

Servo amplifiers work where noise is problem

The models 200 and 201 are pulse-width-modulated servo amplifiers designed to drive dc motors. Both have 26-kHz switching frequencies, so they can be used for applications where acoustic switching noise is a problem and with lower inductance motors without a series choke.

Both provide a 5-A peak at 45 V for 500 ms during periods of rapid motor reversals and 2 A at 45 V during continuous operation. They are intended for driving dc torque motors and linear actuators in robotics, computer-aided design and manufacturing, machine tool, and military applications.

The pwm design permits installation where minimum cooling is available. The amplifiers are also designed to provide full output at 0° to 45°C when mounted without a heat sink or at up to 70°C when mounted on a machined baseplate. Both are available with an internal heat sink permitting operation at up to 55°C ambient or 60°C with forced air.

The 200 and 201 differ only in that the 201 contains an internal dc-to-dc converter. High-voltage power requirements are from +20 to 50 V for the 200 and ±15 V for the 201.

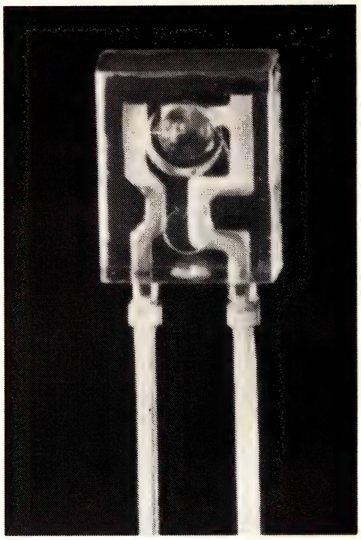
Both are available now. Prices for the 200 and 201 range from $220 to $265 in quantities of one to nine.

Copley Controls Corp., 375 Elliot St., Newton, Mass. 02164.
Phone (617) 965-2410 [Circle 355]

GaAlAs diode replaces GaAs for most applications

An infrared-emitting diode, the F5G1, is fabricated in gallium aluminum arsenide. Said to offer from three to five times greater system efficiency over standard gallium arsenide diodes, it can take their place in most uses.

It operates at an 880-nm wavelength, compared with 940 nm for typical GaAs IR LEDs. Since the peak electrical response of silicon detectors is approximately 850 nm, the F5G1 is said to be a better match spectrally.



The diode complements the L14Q phototransistor and the L14R photodarlington detector. It is rated at 0.6 mW/steradian radiant intensity at 20 mA input. Its operating temperature range is –55°C to +100°C. The unit is encapsulated in a side-looking molded plastic housing with recessed lens.

Available now at 75¢ each when ordered in lots of 1,000, the F5G1 has a wide-beam angle of ±30° at half-power. It is capable of high-pulse power operation, with a peak capability of 2 A.

General Electric Co., West Genesee St., Auburn, N.Y. 13021
[Circle 357]

Tach-eliminator converters are accurate to within 1%

Eliminating the need for electromechanical tachometers in control systems, a line of hybrid resolver-to-digital converters provides velocity feedback and digital conversion from one compact module.

The RDC-19190 series provides ±1% linearity velocity output. Converters are available in resolutions from 10 to 16 bits, with accuracies that range from ±21 to ±1.3 min, respectively. Input frequency for the 10-bit-resolution model ranges from 360 Hz to 22 kHz. In addition, resolver or direct inputs at 11.8 V and 2.0 V line to line are available. All units operate with a reference voltage range between 4 V and 50 V, on 0.3 W.

Maximum tracking rates range from 400 to 6.3 revolutions/s for 10- and 16-bit converters, respectively. Typical applications are in motor- and position-control systems for robotics, computer-numeric-control machine tooling, and precision antenna positioning.

Prices for the RDC-19190 series start at $133. Delivery will take four to eight weeks.

ILC Data Device Corp., 105 Wilbur Pl., Bohemia, N.Y. 11716.
Phone (516) 567-5600 [Circle 346]

Autoranging CMOS ADC has 22 operating ranges

Automatic range selection that eliminates rotary switches or complex printed-circuit-board contact patterns, over a total of 22 operating ranges, is offered by the TSC805, a 3½-digit integrating analog-to-digital converter. There are nine measurement ranges for dc-ac voltage, four for ac-dc current, and nine for resistance and low-power ohms. The low-ohms measurement option allows circuit-resistance measurements by preventing semiconductor junctions from being forward biased.

Autoranging works for resistance scales from 200 Ω to 2 MΩ, and voltage ranges from 200 mV to 2,000 V. Two user-selectable 20-mA and 200-mA current ranges are available.

Standard digital multimeter functions such as ac-dc voltage, ac-dc current, resistance, and low-power-resistance options are on chip. The TSC805 also provides a two-digit memory on chip for relative measurements. Because annunciator drivers are also on chip, additional external-display drivers are not required. A standard triplex liquid-crystal display is available.

Additional features are overrange detection, low-battery detection, continuity detection, and a 50% extended-resolution manual operating mode. The latter option extends the resolution by 50%—to 1 part in 3,000.

Noise on the TSC805 is typically 20 μV, and maximum internal voltage reference drift is 50 parts per million per degree C.

Available in a 0.5-in.^{2} plastic quad flat package, the TSC805 sells for $13.20 each in 100-piece quantities. Samples are available now, and production-quantity delivery is in 8 to 10 weeks.

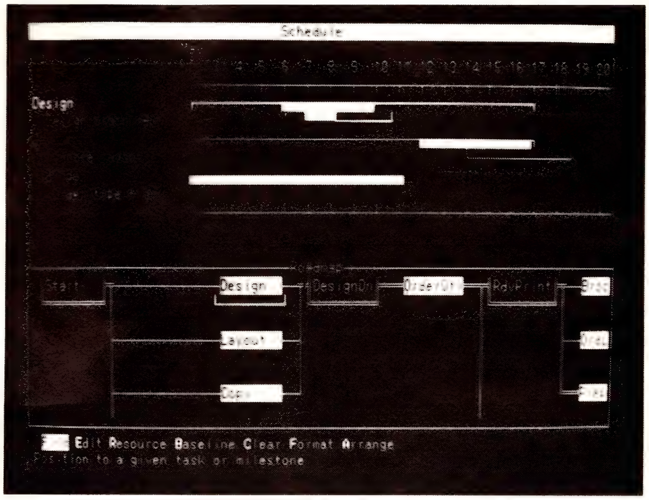
Teledyne Semiconductor, 1300 Terra Bella Ave., Mountain View, Calif. 94043. Phone (415) 968-9241 [Circle 347]

Project planner manages multiple projects at once

The Total Project Manager is a package offering on-screen graphics and comprehensive resource management compatible with the IBM Corp. Personal Computer. Management of the resource pool is subject only to memory and disk space.

Users can plan management projects for resources such as employees and equipment and determine the availablity and cost of the resources assigned. "What-if" scenarios, such as employee absences or equipment failures, are also possible.

The package also allocates resources for multiple projects and measures their progress against the original plan at any time. It employs the basic planning techniques of Critical Path Method and uses Gantt and Program Evaluation and Review Technique charts for visual emphasis. Data in the project can be transferred to programs that accept Data Interchange Format files such as Lotus 1-2-3, Symphony, and Visicalc.



Position to a given task or milestone

The package runs on IBM PC, XT, and AT and other compatibles under PC-DOS version 2.0. It requires 384-K bytes of memory and either two double-sided disk drives or one double-sided disk drive and a hard-disk drive. Color and monochrome monitors are supported.

The Total Project Manager is available now and sells for $495.

Harvard Software Inc., 521 Great Rd., Littleton, Mass. 01460.
Phone (617) 486-8431 [Circle 363]

Software speeds CMOS gate array design, testing

A software package called Easygate aids in the design and testing of CMOS gate arrays. Customers can design 2-to-4-μm arrays at their own facilities when the software package runs on a Daisy or Mentor work station.

Easygate includes line delay corrections for fan-out, temperature, and voltage. Customers may simulate directly with Sentry-compatible test vectors to verify both design and testability. Once completed, output of the final design goes onto an 8-in. floppy disk and is mailed to the manufacturer.

Available now, the Easygate software package with macro cell library and software manuals is priced at $2,000.

International Microcircuits Inc., 3350 Scott Blvd., Bldg. 37, Santa Clara, Calif. 95051. Phone (408) 727-2280 [Circle 364]

Pen and tablet execute draw, graph, trace commands

Developed for the firm's Penpad 320 tablet, a presentation graphics software package called Videogram can execute draw, color, graph, and trace functions. The software and pen are compatible with the IBM Corp. Personal Computer.

The pen, which is attached to the Penpad, is also used to invoke the Videogram commands appearing at the top of the tablet as a series of color icon boxes. Videogram gives the user such features as 16 colors, 37 fonts, and a shape library.

It includes an interface to the Polaroid Palette instant slide-making system, which can be activated through a Videogram command. For producing paper and transparent hardcopies, Videogram also supports a variety of dot-matrix and ink-jet printers.

The Videogram pen-and-software package sells for a retail price of $300, and is available now.

Pencept Inc., 39 Green St., Waltham, Mass. 02154.
Phone (617) 893-6390 [Circle 365]

Software for PC/MS-DOS does symbolic debugging

A debugger designated as Pfix 86 and an enhanced version with symbolic-debugging and overlaid-programming capabilities are designed for use in systems based on the Intel 8088/8086 line of processors running PC-DOS and MS-DOS.

Symbolic debugging accepts symbol names whenever the user would normally have to type in an address. Pfix 86 Plus requires the use of the firm's Plink 86 linkage editor in order to execute symbolic debugging of overlaid programs.

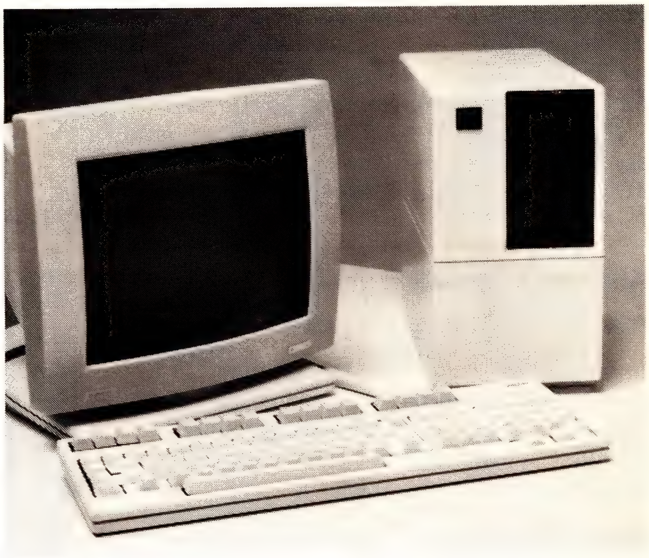
Pfix 86 is designed for use with assembly or high-level programming languages in the MS-DOS environment. It features a multiple-window display for simultaneous viewing of program code and data, breakpoint settings, current machine register, and stack contents. It also provides advanced breakpoint capabilities, including permanent and temporary settings, an in-line assembler, and it supports single-keystroke tracing.

Available now, Pfix 86 is priced at $195, and Pfix Plus at $395.

Phoenix Computer Products Corp., 1416 Providence Hwy., Suite 220, Norwood, Mass. 02062.
Phone (617) 762-5030 [Circle 366]

Smart display is upgradable to PC-compatible station

Original-equipment manufacturers and systems integrators are the targeted users for a display terminal that is compatible with the Digital Equipment Corp. VT-220. Designated the WS-1000, the terminal can be upgraded to a work-station configuration that is compatible with the IBM Corp. Personal Computer XT. The intelligent terminal also features plug-in expansion cartridges for firmware customization.



When XT-compatible, it can be operated as either an independent terminal or a fully-compatible PC-DOS work station. When the WS-1000 line is detached from the PC mode, the terminal operates as a user-defined DEC VT-220 emulator. With 16-K bytes of read-only memory and DEC VT-220 emulation firmware, the station's Z80A-based processors have an IBM-compatible bus and video logic.

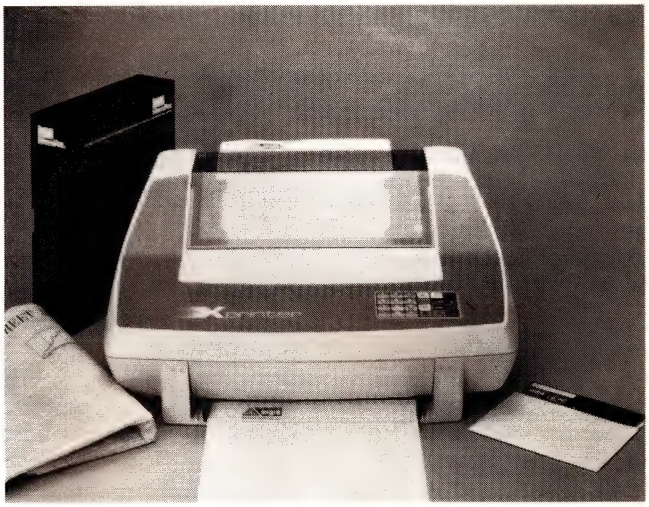
The 14-in. monochrome work station has 80-column-by-25-line alphanumeric and character graphics, and a 50-Hz noninterlaced refresh rate.

Available now, the WS-1000 terminal is priced at $995. When expanded with a PC connection module and floppy-disk drive, the price is $2,595. The terminal plus the PC connection module with one floppy drive and one Winchester drive is priced at $4,845.

Zentec Corp., 2400 Walsh Ave., Santa Clara, Calif. 95050.
Phone (408) 727-7662 [Circle 370]

Low-cost, three-mode unit prints up to 180 characters/s

A bidirectional 80-column dot-matrix unit prints draft-quality documents at 180 characters/s, letter quality at 120 characters/s, and near-letter quality at 50 characters/s. The unit's print pitch can be adjusted to 10, 12, 14.4, 15, or 17 characters/in., and different characters



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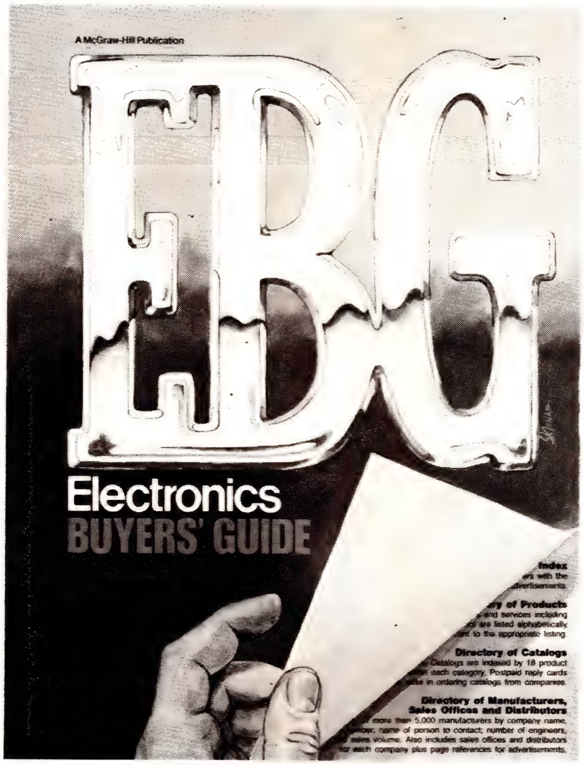
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can be downloaded by means of the unit's firmware.

Weighing 16 lb and intended for use with the IBM Corp. Personal Computer, the unit also prints international characters, superscripts, subscripts, and images. It comes with friction and tractor feeds for handling flexible forms as well as AutoSheet load, a feature that automatically sets a sheet to the correct printline when inserted.

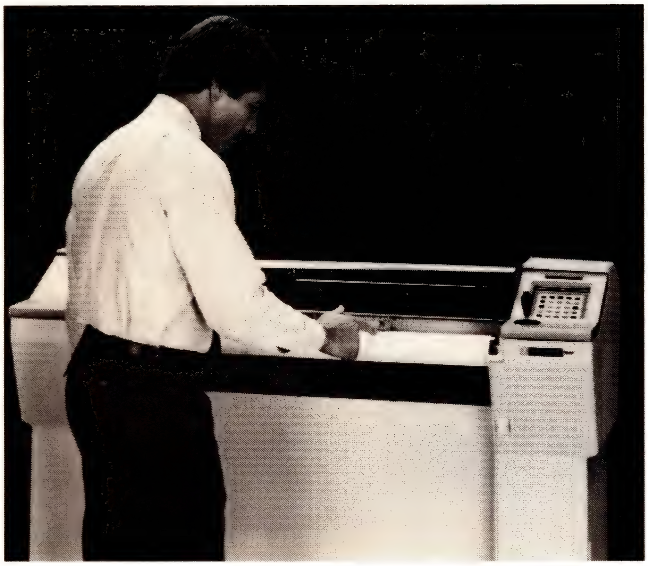
Optional features include a repeat mode, which can be used to reprint a document, and the Sidewinder mode, which can be used to rotate text or spread sheets 90°, giving almost unlimited printing width without changing software. A 64-K buffer facilitates the spooling of 34 or more pages of text in the printer.

Selling for $695, the printer is available now.

Micro Peripherals Inc., 4426 S. Century Dr., Salt Lake City, Utah 84123. Phone (801) 263-3081 [Circle 367]

Eight-pen unit features full-width plotting

An addition to the firm's 1040 series of cut-sheet, dual-mode plotters, the model 1044 features eight pens and a full-width plotting capability that extends to American National Standards Institute size E or International Organization for Standardization size AO.



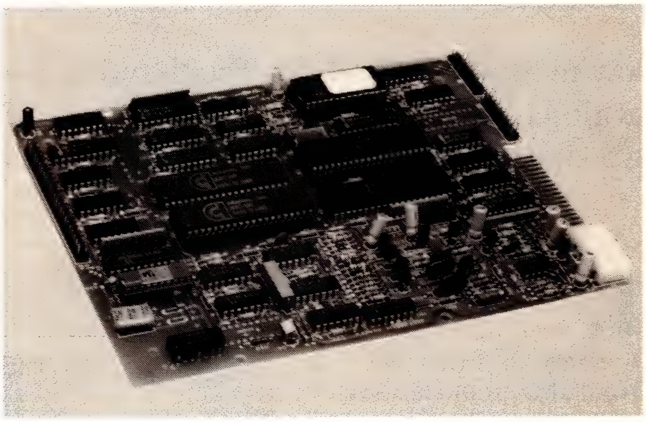
The 1044, which supports engineering and construction applications, along with integrated-circuit and printed-circuit board design, sells for one-half the price of comparable competitive units, the firm says.

The model 1044 operates in both cut-sheet and continuous-roll modes, letting users produce single plots and batch jobs in production environments. Key features include an eight-pen turret with automatic pen capping, an integrated communications interface, non-volatile setup memory, and self-diagnostics. The plotter also features an intelligent control panel with tactile-feedback buttons and a 40-character display that adjusts to reduce light reflections.

Scheduled to be available in December, the model 1044 sells for $11,995. Substantial discounts are available for original equipment manufacturers.

Calcomp, 2411 W. LaPalma Ave., Anaheim, Calif. 92801. Phone (714) 821-2142 [Circle 368]

Encoder/decoder hikes disk capacity by 50%



A version of the firm's encoding/decoding chip, a 10-Mb/s 2/7 run-length-limited chip, increases the capacity and performance of storage systems. The chip, which is designated the AIC-270, executes the encode/decode function that converts run-length-limited data from the disk into nonreturn-to-zero data for the controller.

A Small Computer System Interface controller board that employs the encoding/decoding scheme works with the company's V100 drive series. Compared to the standard modified frequency-modulated scheme, a controller using this scheme can store more data with the same flux density, yielding up to 50% more disk capacity and data transfer speed for the same storage cost.

Many standard 5-Mb/s ST506 drives have enough margin in their media and read/write channel so that it is possible to use them directly with the ACB-4070 controller board without modifying either the drive or media technology. The ACB-4070 controller board operating in conjunction with the AIC-270 is designed for single-user microcomputers. Using the run-length-limited controller, equipment manufacturers will be able to configure a storage system with the firm's V170, a 72-megabyte drive, and achieve 108 megabytes of capacity at no extra cost for the drive.

The AIC-270 sells for $23.50 in quantities of 100 or more, the board for $280. Small quantities of both are available now.

Adaptec Inc., 580 Cottonwood Dr., Milpitas, Calif. 95035. Phone (408) 946-8600 [Circle 371]

Programmable system manages 500 components

A computer-based monitoring and management system is designed for large data-processing, communications, and similar systems that contain multiple electrical, electronic, pneumatic, or engine-driven setups. Applications for the user-programmable system, which can be operated by nontechnical personnel, include uninterruptible power supplies and motor generators, as well as telecommunications equipment.

The system provides all data either on a color display screen or as black and white hard copy and graphics. Data can be viewed at any time and can be reviewed historically, covering any period defined by the user. Thus the user can monitor trends and cycles, as well as time, date, and sequence of events. By invoking preprogrammed keys, users may view the status of the entire system, any of 55 zones, or any one of up to 500 individual components.

For the continuous monitoring of up to 500 individual components, the system's features include a foreground/background system architecture to handle alarms, emergencies, and other management functions. The system monitors utility power, component on-off status, temperature, humidity, smoke, water, and other ambient or operating conditions.

At a base price of $17,000, the system includes an IBM Corp. Personal Computer XT with a 10-megabyte fixed disk, keyboard, color monitor, graphics printer, and system interface unit. It is available in 14 weeks.

K/W Control Systems Inc., Dept. MMS, South Plank Rd., Middleton, N.Y. 10940. Phone (914) 355-6741 [Circle 369]

Power-supply load module works alone, in ATE system

Providing loads from 0 to 50 A and 2 to 50 V dc, the model A50 programmable power-supply module works as a portable, manually operated test system, or in combination with up to 10 other load modules in the company's Qualifier automatic-test-equipment system.

In the manual mode, the A50 provides up to five loads ranging from 0 to 1 A to 0 to 50 A with an accuracy of ±1.0% of full scale. It has a maximum capacity of 250 W and a voltage range of 2 to 50 V dc, which is stable to within 0.1%.

Operated by push buttons, the system can quickly test power supplies for short circuits, and the current outputs can be continuously monitored on its linear panel meter. With a two-pin plug on the front panel, the operator can connect the unit under test for remote voltage sensing. A three-way switch lets the operator select either constant current or constant resistive loads, or connect the module into the Qualifier.

Priced at $850, the module is available from stock.

Datapower Inc., Department QTS, 3328 W. First St., Santa Ana, Calif. 92703. Phone (714) 775-2000 [Circle 372]

System produces graphics from VCRs, video cameras

The Video Production System was developed for use with the manufacturer's personal computer to create and display graphics. The system can be integrated with any standard NTSC video signal.

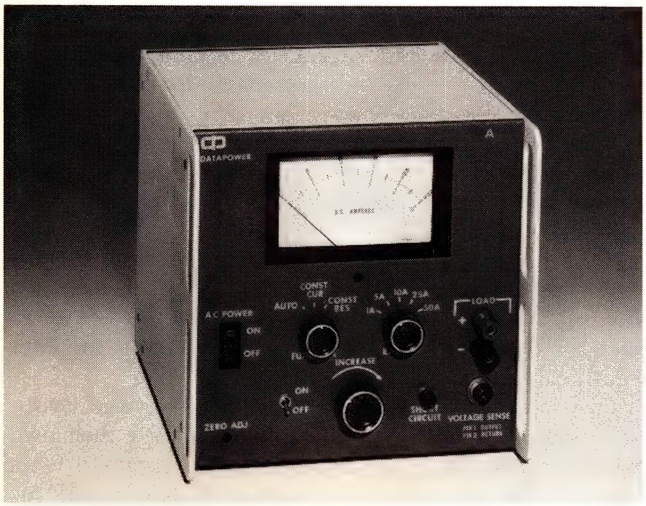
The system is made up of three hardware components—the system unit, the video production module, and an optional expansion unit. The system unit is a modified version of the central processing unit used in the firm's personal computer, and is built around the company's very large-scale integrated graphics coprocessors and the Intel 80186.

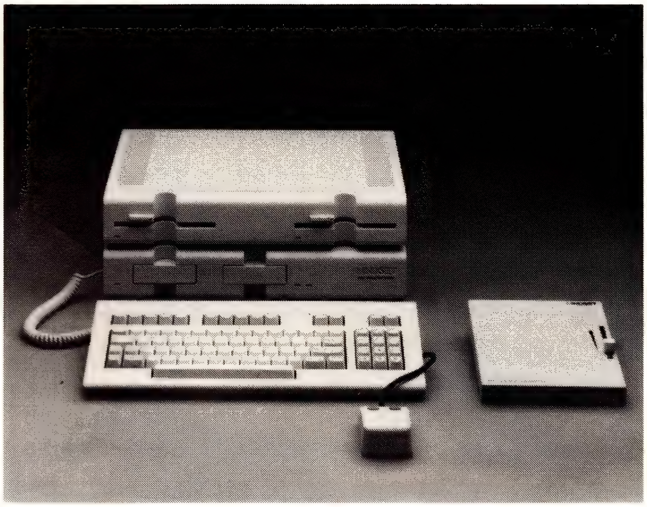
The system's memory ranges from 32-K- to 384-K bytes; up to 720-K bytes of floppy-disk storage is available. A fully configured system has six input/output ports and comes with built-in red-green-blue, composite, and television display interfaces. With a television or composite display, the system creates a 320-by-200-pixel screen that can simultaneously display 16 colors from a palette of 512 colors.

In an alternate mode, the system generates a 640-by-400-pixel resolution using two colors. Without modification, the system also functions as a personal computer compatible with most programs written for the IBM Corp. Personal Computer and the firm's software.

Available now, the basic video production system base unit sells for $1,599.

Mindset Corp., 617 North Mary, Sunnyvale, Calif. 94086. Phone (408) 737-8555 [Circle 373]





DUAL-PROCESSOR UNIX MACHINE SERVES 8 USERS

Vendors gather at this fall's Comdex, Las Vegas, Nov. 14-17, to unveil a well-rounded lot of computers, peripherals, and software

☐ *by Steve Zollo*

Based on the 68010 microprocessor, the Plexus P/15 computer system is optimized to run the AT&T Bell Laboratories Unix operating system and serve up to eight users. It is being added to Plexus's line on the low end, and is compatible with the line's other systems.

As do the other Plexus computers, the P/15 features a multiprocessor architecture that uses two 68010 processors, a memory capacity of up to two megabytes, and eight full-duplex serial ports for peripherals.

The P/15, which measures 75 in. high and weighs under 75 lbs, is packaged to fit in the limited space often found in the typical business office. The system is self-contained, allowing for two Winchester disk drives to hold up to 54 megabytes as well as for a single 5¼-in. double-sided floppy-disk drive. It uses a standard 115-V ac supply line.

The first of the unit's two processors, the input/output processor controls a Small Computer Systems Interface subsystem offering full error-correction facilities as well as full SCSI functions to serve the hard- and floppy-disk drives. In addition, the I/O processor handles all character I/O to and from the eight serial ports, thus removing this overhead from the job processor.

The 10-MHz central processing unit, which Plexus calls the job processor, operates with no wait states through a shared high-speed map with eight megabytes of address space. It supports the Institute of Electrical and Electronics Engineers' proposed standard for floating-point arithmetic. Using 256-K of random-accees memory, the P/15's memory is available with up to one million 16-bit words.

Available 120 days after receipt of order, the P/15 with ½ megabyte of memory, 12 megabytes of Winchester disk storage, and 1 megabyte of floppy-disk storage sells for $10,950.

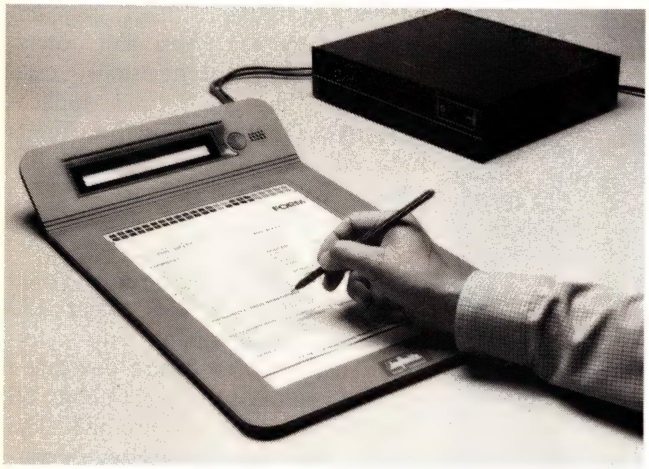
Plexus Computers Inc., 3833 N. First St., San Jose, Calif. 95134. Phone (408) 943-9433 [Circle reader service number 390]

Pen-like device replaces keyboard for data entry

Those who don't want to give up pen and paper but want to take advantage of a computer will want to try the Hand-Written Data Entry device. The tablet and pencil-like device is said to expand the capabilities of a standard keyboard.

The device recognizes a wide range of data, including hand-printed letters, numbers, and check marks; in addition, it captures free-hand graphics, sketches, hand-written notes, and signatures. With one-touch mark sensing, data is entered by checking boxes. Examples of the device's use are order entry, test scheduling, menus, and examination forms. It transfers data directly to a computer or data base or stores it in its memory for later transmission to a computer.

Two software packages are available. With the forms-definition sytem, users can design or customize their own business forms. With the data-conversion program, users can store data from the entry device on disk in DIF file



format using an IBM Corp. Personal Computer. The Hand-Written Data Entry device sells for $1,950, and the two software packages go for $450 and $100 each, respectively.

Inforite Corp., 1670 S. Amphlett Blvd., Suite 201, San Mateo, Calif. 94402. Phone (415) 571-8766 [Circle 391]

With scanner, IBM PC manipulates text, graphics

Based on flat-bed scanner technology and incorporating the firm's WIPS software, the model 700 word- and image-processing system links with most popular IBM Corp. Personal Computer word-processing and data-base-management software so that users can create complex documents and data bases that integrate images and alphanumeric text. The 700, to be available next March for $4,000, operates with the IBM PC, PC/XT, or PC AT as a peripheral.

The system consists of the 210 graphic scanner, the 111 imaging interface, the software, and cables. The scanner is designed so that 8½-by-11-in. papers, cards, or books can be easily placed on the scanning bed. Selectable halftone patterns and three contrast levels provide for continuous tone scanning and optimum imaging.

Resolution of the scanned image is 200 dots/in. across the horizontal scan line; the user can select either 200, 150, or 100 lines/in. in the vertical dimension.

Datacopy Corp., 1215 Terra Bella Ave., Mountain View, Calif. 94043. Phone (415) 965-7900 [Circle 392]

Smart modem offers double security

A variety of security features is offered in the Cermetek Security Modem, a unit compatible with Hayes's 1,200-, 300-, and 110-b/s modems. The modem guards a computer against unauthorized access by requiring the caller to have a valid password and a specified callback telephone number.

The number associated with the password is stored in the modem's nonvolatile memory, which can store passwords and associated callback numbers for up to 25 users. Beyond this basic level, the modem supports a more elaborate password and callback scheme for business requiring greater protection.

In this case, the user can set the modem to accept calls on one line and make callbacks on a second line. The phone number for the outgoing line can be kept secret, preventing a security breaker from intercepting the callback.

In addition to the password and callback system, the modem provides four other security measures: an audit trail, a dial-out password, a key for changing security levels, and security decals to discourage tampering. The intelligent modem, compatible with Bell 212A and 103 standards, is available now for $695.

Cermetek Microelectronics Inc., 1308 Borregas Ave., P.O. Box 3565, Sunnyvale, Calif. 94088. Phone (408) 752-5000 [Circle 393]

Programs give IBM PCs phone-management abilities

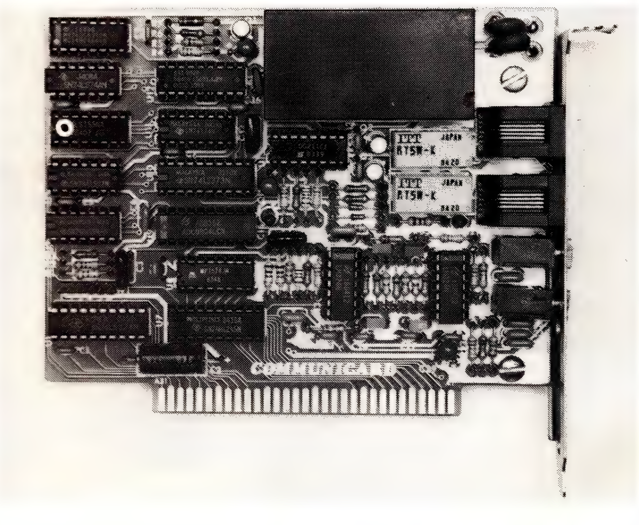
With a line of communications software programs called the SoundWare Series, an IBM Corp. Personal Computer or PC/XT can perform intelligent telephone answering and management activities. The package also includes tools with which software developers can write applications with voice-communications capabilities.

For those who want to develop software applications with voice-recording capabilities, the company provides SoundTools, which can be used with several programming languages including Basic, C, Pascal, and assembly languages. SoundTools includes such functional calls as record a file, play a file, receive a tone-key digit, and generate a tone-key digit.

Communicard, a voice-communications card, also provides automatic tone-key recognition; a phone handset can be used to input voice messages.

The SoundWare package includes the Communicard, a disk with VoiceMate and SoundTools software, a cable, and a reference manual. It sells for $449. Orders are being taken now for delivery after Comdex.

Digital Pathways Inc., 1060 East Meadow Circle, Palo Alto, Calif. 94303. Phone (415) 493-5544 [Circle 394]



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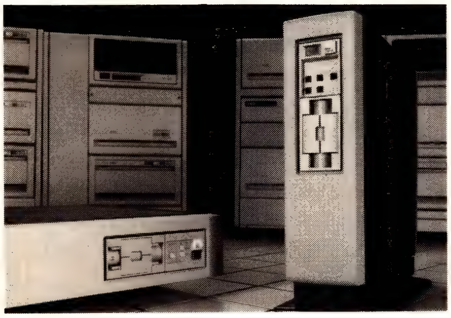

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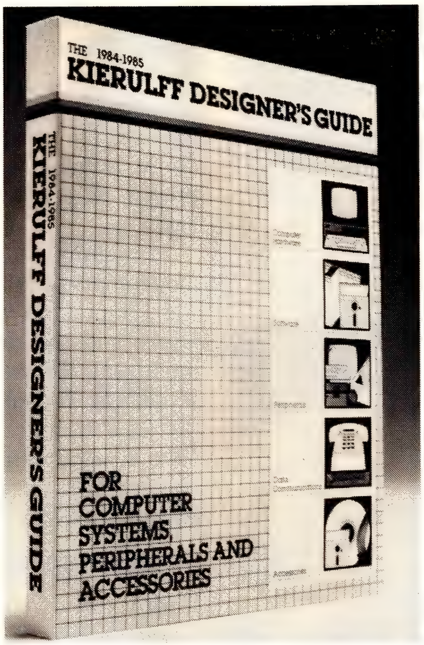

THE 1984-1985 KIERULFF DESIGNER'S GUIDE
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Guide service. A 350-page, single-source reference, *Kierulff Designer's Guide,* provides information on computer products and systems, software, peripherals, and more from over 25 manufacturers. Each product area contains an overview and tables of product specifications and performance features. Data sheets and photographs end the section. The prepublication price is $37.50 until Dec. 15, $75 thereafter. For order information, call the Kierulff Response Center at (800) 338-8811. The guide is published by Kierulff Electronics Inc., 2585 Commerce Way, Los Angeles, Calif. 90040.
[Circle reader service number 421]

Salute it. A technical brochure on the manufacturer's MIL-STD-1553 chip sets in individually packaged or hybrid assembly form, for interfacing and bus control among other applications, has just been released. Copies are available from Marconi Electronic Devices Ltd. (Hybrid Division), The Railway Triangle, Walton Rd. Portsmouth, Hants PO6 1TN, England. [Circle 424]

Light and air. "A Window on the World of Diodes" is a six-page catalog from a manufacturer of diodes and diode rectifiers. Types described include general-purpose and fast-recovery silicon rectifiers, Schottky barrier and bridge rectifiers, germanium point-contact types, and others. Data includes specifications, case and lead dimensions, and applications. Ask for the catalog from International Components Corp., 105 Maxess Rd., Melville, N.Y. 11747. Phone (516) 293-1500. [Circle 422]

32 bits of advice. The series 32000 software catalog covers about 130 products and contains cross-referenced listings of software developed by the manufacturer and about 50 other vendors for the product. The catalog lists Genix and Exec operating systems; cross-software, languages, and compilers; other systems software; and many applications programs. For a free copy, write to the Literature Department of National Semiconductor Corp., 2900 Semiconductor Dr., M/S 23-205, Santa Clara, Calif. 95051, or phone Technical Referral at (408) 721-4902.
[Circle 423]

Hot stuff. This data sheet describes a line of miniature hybrid modules, X-band beryllium oxide microwave integrated circuits. The modules feature flip-chip-mounted gallium arsenide FETs and high-thermal-conductivity beryllium oxide. Data sheet TE-835 is available without charge from Microwave Semiconductor Corp., 100 School House Rd., Somerset, N.J. 08830. Phone (201) 469-3311. [Circle 428]

Road to Hong Kong. A 1,160-page hard-cover directory, the *Asia Electronics Directory* lists over 6,000 manufacturers, exporters, importers, distributors, and wholesalers that do business in the Far East. Section I contains company profiles, while Section II organizes the directory by product category. This is also a reference source for new lines by U.S. manufacturers' representatives and distributors. The directory, which sells for $125, is available from Electronic Trend Publications, 10080 N. Wolfe Rd., Suite 372, Cupertino, Calif. 95014. Phone (408) 996-7416.
[Circle 432]

Graphics grabber. A two-page product sheet describes the Concept

GVT+ graphics display terminal, giving its capabilities in graphics mode or in interactive-display mode, among other functions. Physical characteristics of the terminal are also described in detail. Request this product sheet from Human Designed Systems Inc., 3440 Market St., Philadelphia, Pa. 19104, or telephone the company at (215) 382-5000. [Circle 431]

Everything's under control. An eight-page color brochure describes the model 2800, a control system for machine automation, and the format used for its sequential programming method. This approach rejects the traditional relay-ladder logic and instead comes out in favor of programming a series of steps in their natural order. Ask for the brochure from Control Technology Corp. at (617) 435-9595, or write to the company at 25 South St., Hopkinton, Mass. 01748. [Circle 433]

Build yourself up. A built-up testing system, the 4000 series ac dielectric withstand testers with modular accessories, is featured in instrument catalog SF-4. This condensed catalog describes the firm's complete line of Hypots along with its cable testers, fault locators, megohmmeters, and more. For a copy, write to Associated Research Inc., Sales and Service Dept., 8221 N. Kimball Ave., Skokie, Ill. 60076, or call (312) 647-7850. [Circle 425]
In Canada, write to Brunelle Instruments Inc., 826 Belvedere, Sherbrooke, Quebec J1H 4B8, or phone (819) 569-1408. [Circle 426]

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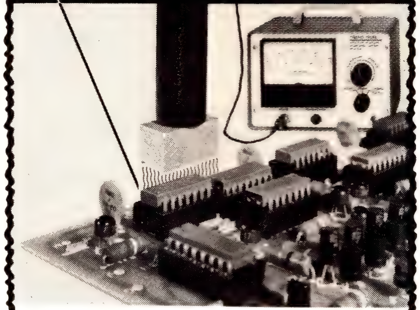

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■ For more information of complete product line see advertisement in the latest Electronics Buyers Guide
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FCC TOSSES BALL TO THE INDUSTRY

The Federal Communications Commission's decision to stop setting standards comes as no surprise. The agency had indicated earlier this year that it would do so, and the philosophic thrust of the FCC as well as the present Administration has been *laissez faire,* with the marketplace being permitted to set standards. As the story on p. 18 describes it, the new policy affects four areas: quality, interoperability of equipment and systems, spectrum efficiency, and interference control. And the FCC will delete a number of standards that define the quality of radio and television signals.

The user community seems to be taking the change calmly for the most part, perhaps because the FCC has been deregulating standards for years. However, that reaction contrasts sharply with the hue and cry generated by the initial announcement. Then, a considerable number of broadcasters and manufacturers rushed to the defense of their vested interest in maintaining the status quo. There were cries of anguish and pain, along with dire warnings that the nation was facing the confusion of another AT&T divestiture as well as a deterioration of standards in general.

The decision by the FCC to forge ahead shows considerable courage and serves as notice to the industry that the agency has a mind of its own. It is now up to the industry to behave wisely and maturely and see to it that the early predictions of disaster turn out to be wrong.

ANOTHER HIGH-TECH ADVANCE FOR FOOTBALL

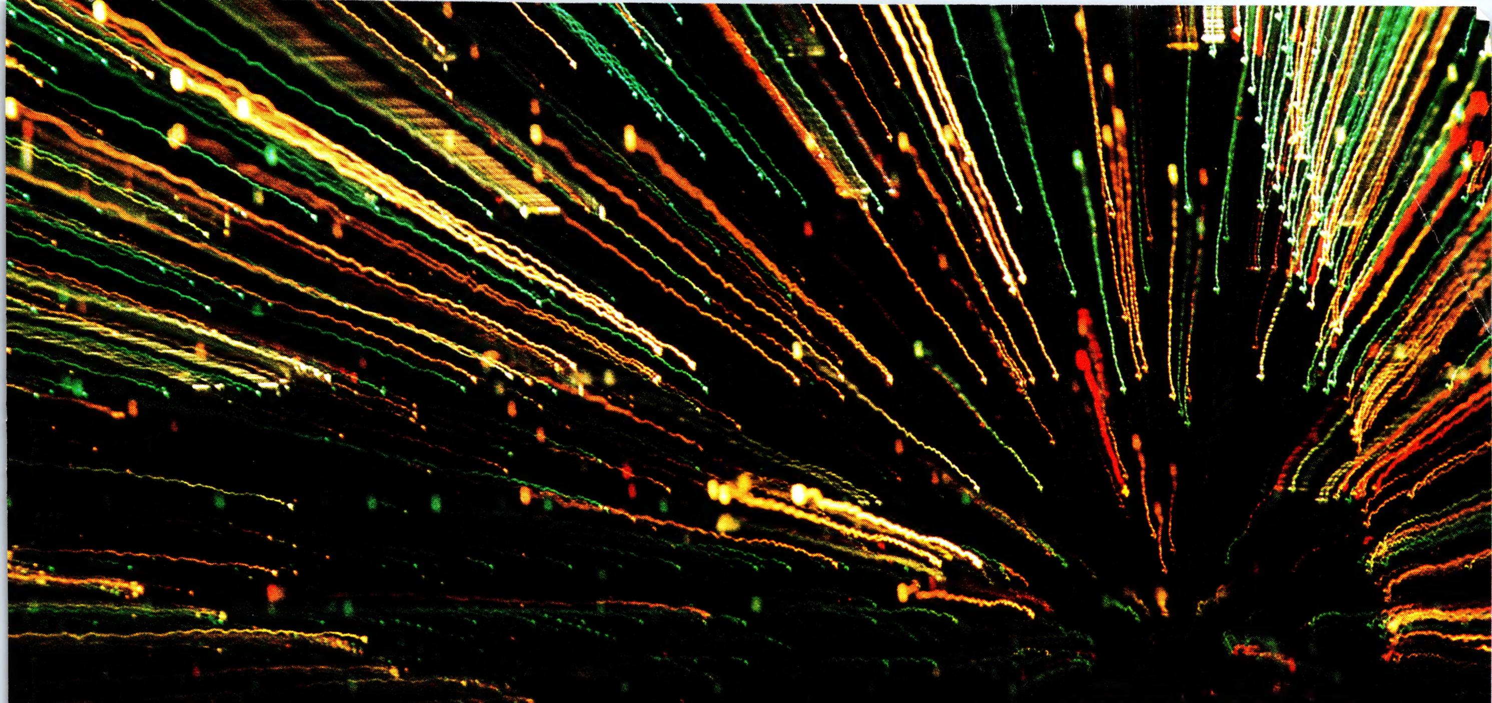
We could have told you so. First there was the covered stadium complete with controlled temperature and humidity, then the imitation grass. Now football appears to be on the verge of getting helmet-mounted receivers so that the quarterback will no longer have to worry about crowd noises drowning out his signals (see p. 22).

It is probably good to make the game more efficient, less susceptible to outside interference, surgically clean. One may say proudly of the technology involved, "Electronics does it again." After all, it was television that made football, on both the professional and big-time college levels, what it is today.

Still, for anyone old enough to remember when football in the late autumn was a game in which rain, snow, sleet, and mud provided a true test for both player and fan; when the game meant slate-gray skies and raw, cutting winds; when snow obscured line markers, mud wiped out sidelines, and rain or sleet chilled fingers, this advance is saddening.

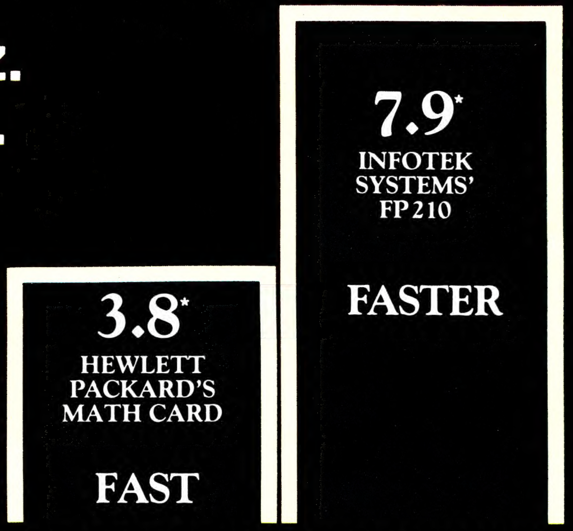
Nowadays, too much money is at stake to permit nature to have her way. Oh, it's nice for electronics people to be able to proudly discuss improvements such as helmet receivers, just as the plastics people must have puffed themselves up a bit when artificial turf replaced the good earth.

But that need not prevent those who remember the way it was from contemplating the past with fondness. The rest of you don't know what you're missing.



Infotek's new FP210, 10Mhz. Floating Point Coprocessor.

The Fastest Performance yet for your Hewlett-Packard Series 200 Computer



THE PROOF IS IN THE NUMBERS

Figure on saving lots of time with Infotek's 10Mhz Floating Point Coprocessor, the FP210, the fastest math card yet.

Compare the numbers of Infotek's FP 210 with Hewlett-Packard's Math Card.

FP 210 FLOATING POINT COPROCESSOR PERFORMANCE DATA USING 3.0

	BASIC				Pascal			
Function	Computer Without Either Card	H-P's Math Card	Ratio	Infotek's FP 210 (10Mhz)	Ratio	Computer Without Either Card	H-P's Math Card	Ratio	Infotek's FP 210 (10Mhz)	Ratio
Add	166	124	1.3	112	1.5	127	74	1.7	60	2.3
Subtract	178	124	1.4	112	1.6	140	74	1.9	60	2.1
Multiply	316	124	2.5	113	2.8	278	74	3.8	64	4.3
Divide	450	128	3.5	117	3.8	416	78	5.3	65	6.4
SQRT	1960	627	3.1	241	8.1	1914	292	6.6	227	8.4
SIN	4093	1002	4.1	524	7.8	3952	618	6.4	496	8.0
COS	4493	1170	3.8	572	7.9	4383	678	6.5	549	8.0
TAN	4223	1075	3.9	519	8.1					
ASN	5369	1192	4.5	641	8.4					
ACN	5367	1195	4.5	644	8.3					
ATN	4415	1026	4.3	533	8.3	4615	665	6.9	545	8.5
EXP	3730	1050	3.6	496	7.5	3605	633	5.7	477	7.6
LOG	3982	1112	3.6	501	7.9	3904	551	7.1	487	8.0
LGT	4245	1183	3.6	533	8.0					
POWER	7799	2555	3.1	1117	7.0					

NOTE: The execution times are in microseconds and are based on a large sample of random numbers.

The FP 210 is designed:
- to work alone or with Infotek's BASIC Compiler
- to run under 2.0 or 3.0
- to operate in Pascal and BASIC
- to be totally transparent in operation
- to meet Infotek's high standards for reliability
- to fit into any slot
- to run existing programs without modification

FP 210 carries a one-year warranty. OEM, government, educational and quantity discounts available. Please call for details.

Specify BASIC or Pascal, 2.0 or 3.0 and disk size when ordering.

INFOTEK SYSTEMS, 1400 N. Baxter St., Anaheim, CA 92806, **Toll free (800) 227-0218.** From California, Alaska, Hawaii collect (714) 956-9300. TELEX 182283

INFAX COMPUTER PRODUCTS GmbH
Neustrasse 9, 6231 Schwalbach/Ts., West Germany, Telefon 06196 86067, TELEX 4 18310 insy d

HP 200 Series computers (216, 226, 236, 220, 217, 237) are products of Hewlett-Packard. * Average performance of Transcendental functions in BASIC.

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